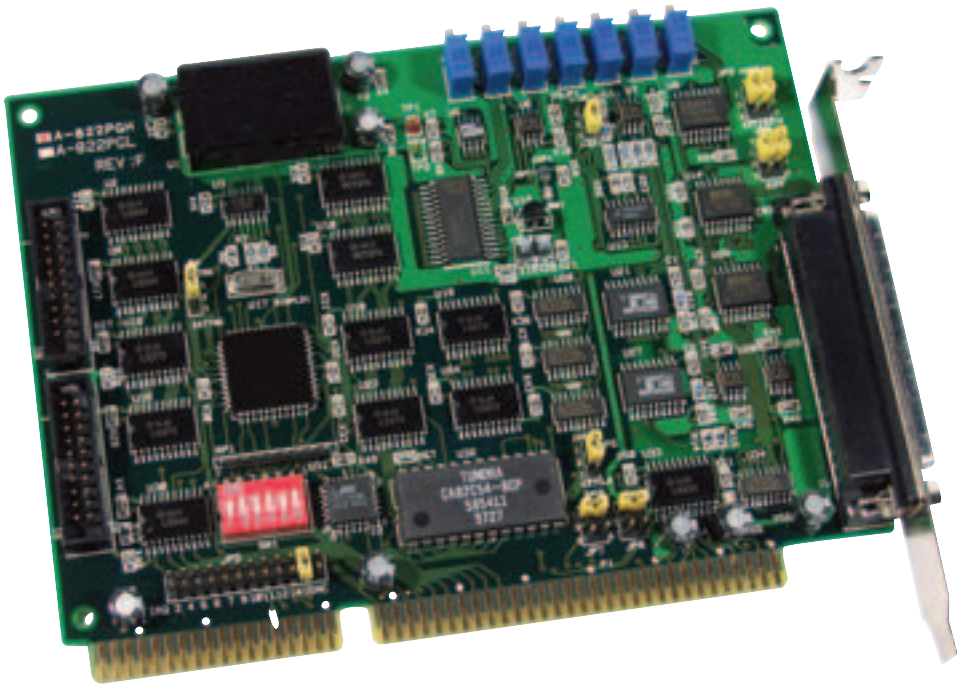
User's Guide



OME-A822PG
ISA-Bus Multi-Functional Board
Hardware Manual

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OME-A-822PGH/PGL

Enhanced Multi-Function Card
Hardware Manual

Tables of Contents

1. Introduction

1.1 General Description

The OME-A-822PGL/PGH is a high performance, multifunction analog, digital I/O board for PC AT compatible computers. The OME-A-822PGL provides low gain (0.5,1, 2, 4, 8). The OME-A-822PGH provides high gain (0.5,1,5,10,50,100,500,1000). The OME-A-822PGL/PGH contains a 12-bit ADC with up to 16 single-ended or 8 differential analog inputs. The maximum sample rate of the A/D converter is 100Ksample/sec. There are two 12-bit DACs with voltage output, 16 channels of TTL-compatible digital input, 16 channels of TTL-compatible digital output and one 16-bit counter/timer channel for timing input and output.

The following A/D performance bench marks were achieved on a 33MHz 486 computer:

- **Polling mode : about 100Ksample/sec (with single-task OS)**
- **Interrupt mode : about 60Ksample/sec (with single-task OS)**
- **DMA mode : about 100Ksample/sec (with single-task OS)**

1.2 Features

- The maximum sample rate of the A/D converter is 100 K samples/sec
- Software selectable input ranges
- PC AT compatible ISA bus
- A/D trigger mode : software trigger , pacer trigger, external trigger
- 16 single-ended or 8 differential analog input signals
- Programmable high gain : 0.5,1,5,10,50,100,500,1000 (OME-A-822PGH)
- Programmable low gain : 0.5,1,2,4,8 (OME-A-822PGL)
- 2 channel 12-bit D/A voltage output
- 16 digital input /16 digital output (TTL compatible)
- Interrupt handling
- Bipolar/Unipolar operation
- 1 channel general purpose programmable 16 bit timer/counter

1.3 Specifications

1.3.1 Power Consumption :

- +5V @960 mA maximum, OME-A-822PGL/PGH
- Operating temperature : -20°C to 60°C

1.3.2 Analog Inputs

- Channels : 16 single-ended or 8 differential
- Input range : (software programmable)

OME-A-822PGL:bipolar : ±10V,±5V, ±2.5V, ±1.25V, ±0.0625V

unipolar : 0 to 10V, 0 to 5V, 0 to 0.2.5V, 0 to 1.25.V

OME-A-822PGH:bipolar : ±10,±5V,±1V, ±0.5V, ±0.1V, ±0.05V, ±0.01V, ± 0.005V

unipolar : 0 to 10V, 0 to 1V, 0 to 0.1V, 0 to 0.01V

- Input current : 250 nA max (125 nA typical) at 25 deg. C
- On chip sample and hold
- Over voltage : continuous single channel to **70Vp-p**
- Input impedance : 10^{10} Ω // 6pF

Caution: refer to Sec. 2.9 first

1.3.3 A/D Converter

- Type : successive approximation , Burr Brown ADS 774 or SIPEX-SP774B (equivalent)
- Conversion time : 8 microsec.
- Accuracy : +/- 1 bit
- Resolution : 12 bits

1.3.4 DA Converter

- Channels : 2 independent
- type : 12 bit multiplying , Analog device AD-7541
- Linearity : +/- 1/2 bit
- Output range : 0 to 5V or 0 to 10V jumper selected , may be used with other AC or DC reference input. Maximum output limit +/- 10V
- Output drive : +/- 5mA
- settling time : 0.6 microseconds to 0.01% for full scale step

1.3.5 Digital I/O

- Output port : 16 bits, TTL compatible
  Output Low: VOL=05.Vmax @IOL = 8 mA max
  Output High: VOH = 2.7Vmin @IOH = -400μA max

- Input port : 16 bits, TTL compatible
  Input Low: VIL=0.8V max; IIL = -0.4mA max
  Input High: VIH=2.0V min; IIL = 20μA max

1.3.6 Interrupt Channel

- Level : 3,4,5,6,7,10,11,12,14,15, jumper selectable
- Enable : Via control register

1.3.7 Programmable Timer/Counter

- Type : 82C54 -8 programmable timer/counter
- Counters : Counter1 and counter2 are cascaded as a 32 bit pacer timer. Counter0 is a user available timer/counter. The software driver also uses counter0 to implement a machine independent timer.
- Clock input frequency : DC to 10 MHz
- Pacer output : 0.00047Hz to 0.5MHz
- Input ,gate : TTL compatible
- Internal Clock : 2 MHz

1.3.8 Direct Memory Access Channel (DMA)

- Level : CH1 or CH3, jumper selectable
- Enable : via DMA bit of control register
- Termination : by interrupt on T/C
- Transfer rate : 100K conversions/sec.

1.4 Applications

- Signal analysis
- FFT & frequency analysis
- Transient analysis
- Production testing
- Process control
- Vibration analysis
- Energy management
- Industrial and laboratory. measurement and control

1.5 Product Check List

The OME-A-8322PGL/PGH includes the following items:

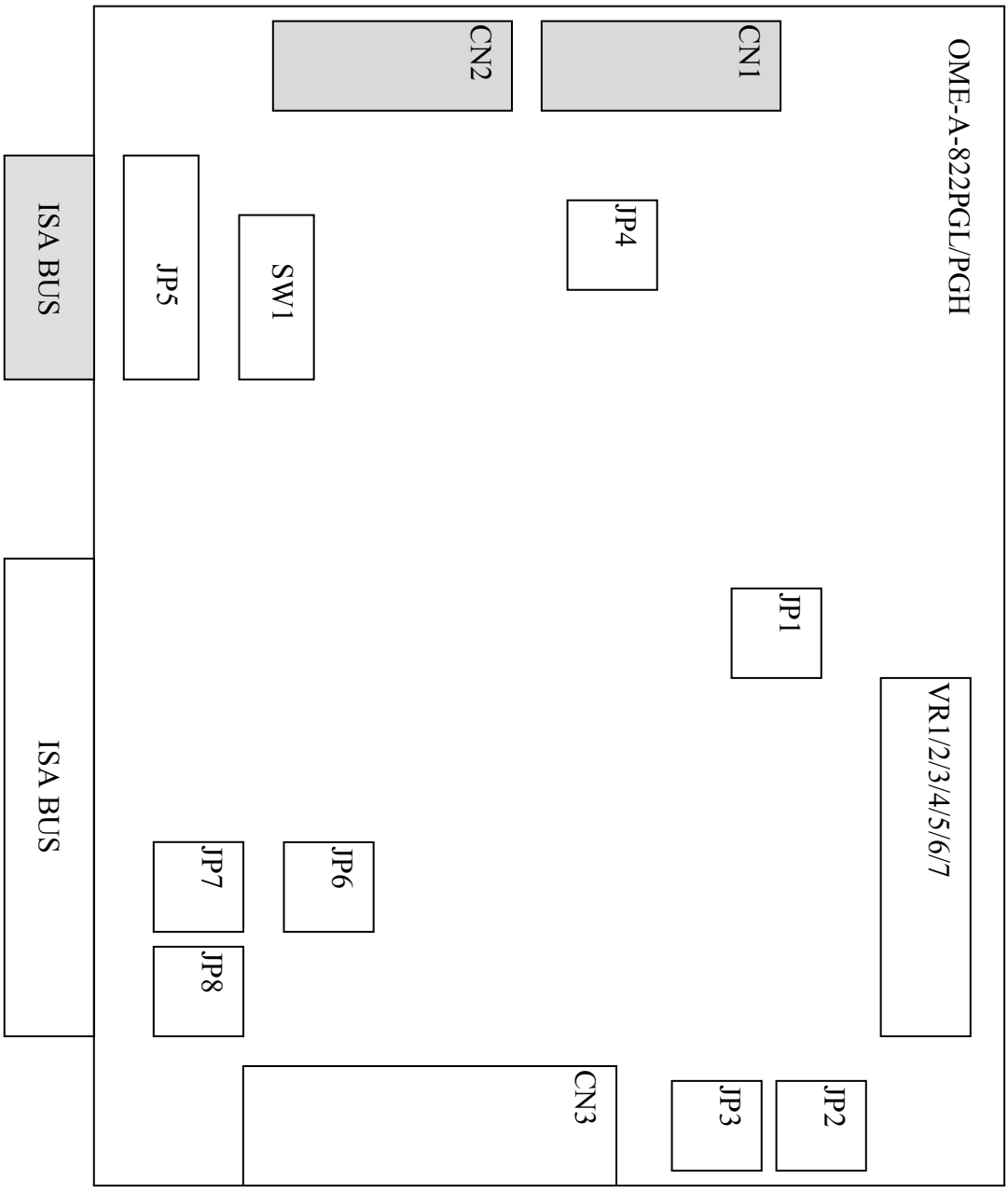
- OME-A-822PGL/PGH multifunction card
- OME-A-822PGL/PGH CD ROM

Attention !

If any of these items are missing or damaged, please contact our customer service department. Save the shipping materials and carton in case you want to ship or store the product in the future.

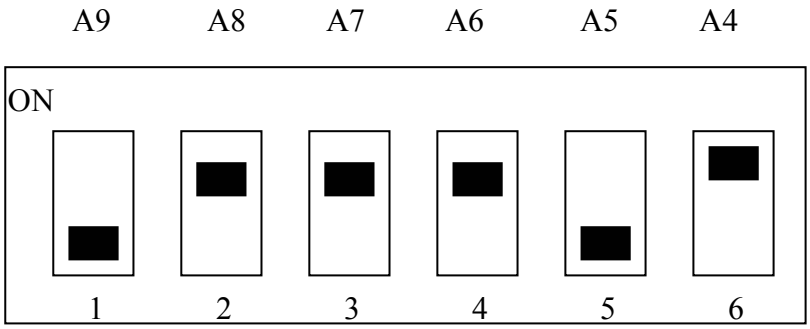
2. Hardware Configuration

2.1 Board Layout



2.2 I/O Base Address Setting

The OME-A-822PGL/PGH occupies 16 consecutive locations in I/O address space. The base address is set by DIP switch SW1. The default address is 0x220.



SW1 : BASE ADDRESS

BASE ADDR	A9	A8	A7	A6	A5	A4
200-20F	OFF	ON	ON	ON	ON	ON
210-21F	OFF	ON	ON	ON	ON	OFF
220-22F(☑)	OFF	ON	ON	ON	OFF	ON
230-23F	OFF	ON	ON	ON	OFF	OFF
:	:	:	:	:	:	:
300-30F	OFF	OFF	ON	ON	ON	ON
:	:	:	:	:	:	:
3F0-3FF	OFF	OFF	OFF	OFF	OFF	

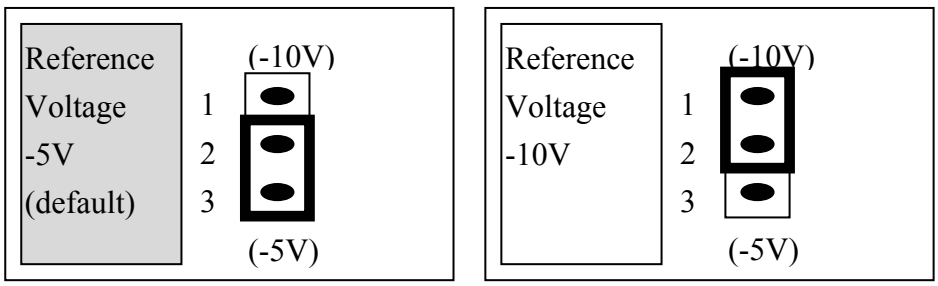
(☑) : default base address is 0x220

The PC I/O port map is given below.

ADDRESS	Device	ADDRESS	DEVICE
000-1FF	PC reserved	320-32F	XT Hard Disk
200-20F	Game/control	378-37F	Parallel Printer
210-21F	XT Expansion Unit	380-38F	SDLC
238-23F	Bus Mouse/Alt. Bus Mouse	3A0-3AF	SDLC
278-27F	Parallel Printer	3B0-3BF	MDA/Parallel Printer
2B0-2DF	EGA	3C0-3CF	EGA
2E0-2E7	AT GPIB	3D0-3DF	CGA
2E8-2EF	Serial Port	3E8-3EF	Serial Port
2F8-2FF	Serial Port	3F0-3F7	Floppy Disk
300-31F	Prototype Card	3F8-3FF	Serial Port

2.3 Jumper Settings

2.3.1 JP1 : D/A Internal Reference Voltage Selection

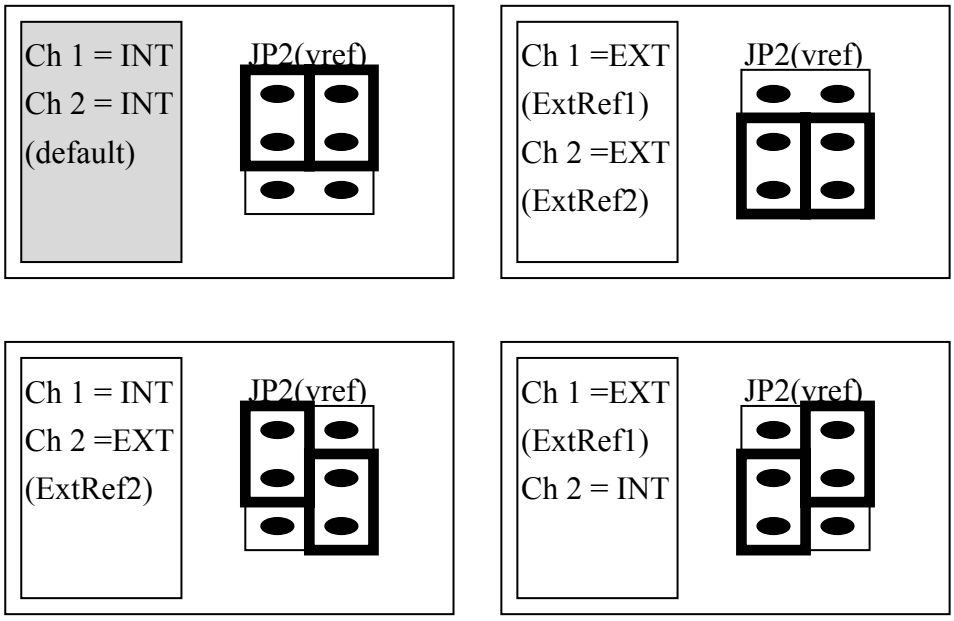


Select (-5V) : D/A voltage output = 0 to 5V (both channel)

Select (-10V) : D/A voltage output = 0 to 10V (both channel)

JP1 is valid only if JP2 is set to D/A internal reference voltage

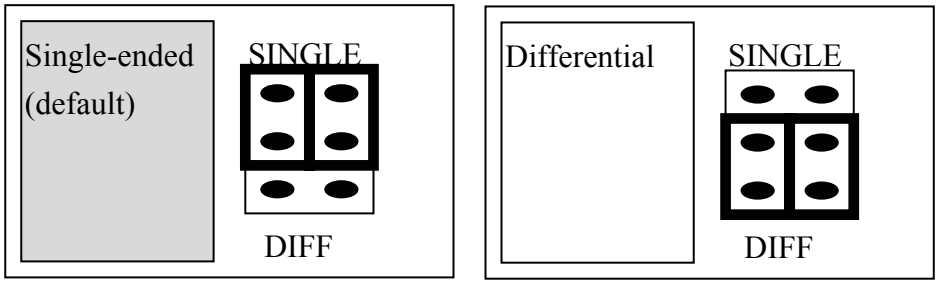
2.3.2 JP2 : D/A Int/Ext Ref Voltage Selection



If JP2 is set to **internal reference**, then JP1 should be set to **-5V or -10V** internal reference voltage.

If JP2 is set to **external reference**, then **ExtRef1, CN3 pin 31**, is the external reference voltage for D/A channel 1. and **ExtRef2, CN3 pin 12**, is the external reference voltage for D/A Channel 2.

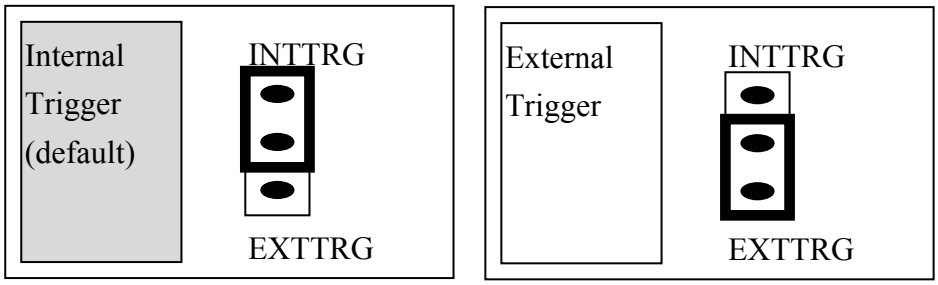
2.3.3 JP3 : Single-ended/Differential Selection



The OME-A-822PGL/PGH offers 16 single-ended or 8 differential analog input channels. The JP3 jumper sets the inputs to single-ended or differential mode. You can not select single-ended and differential simultaneously.

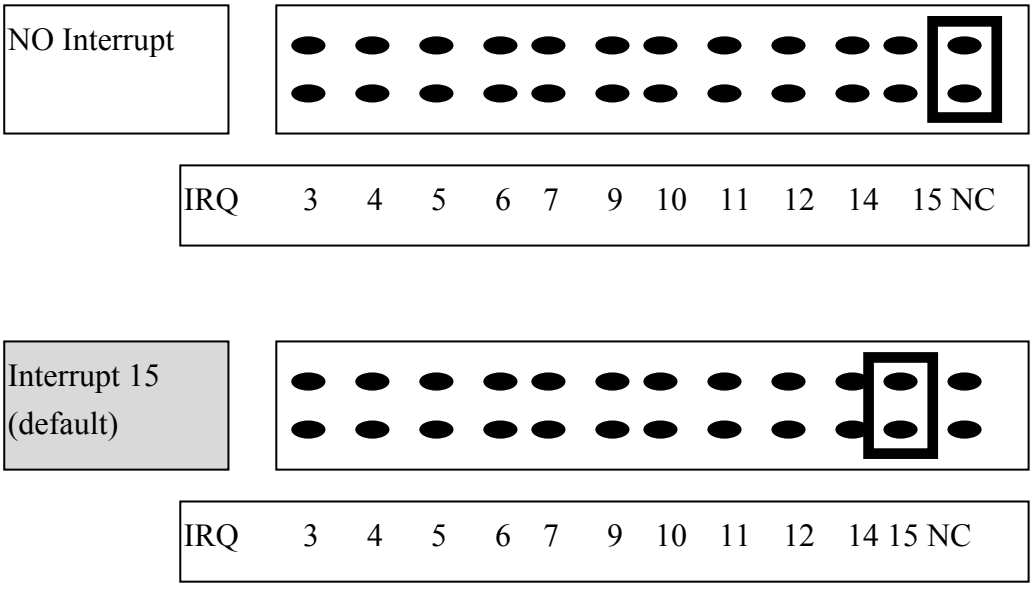
Refer to Sec. 2.9 first.

2.3.4 JP4 : A/D Trigger Source Selection



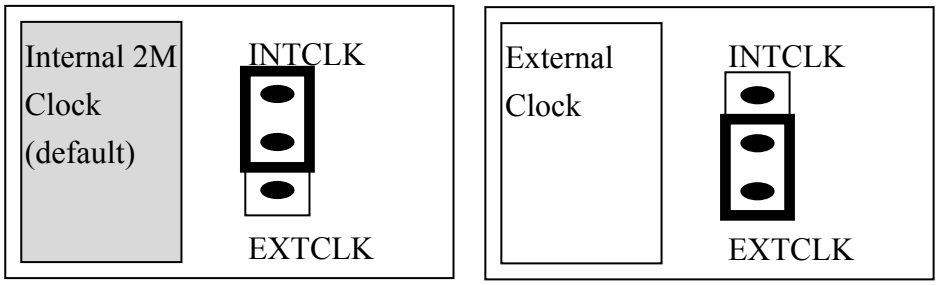
The OME-A-822PGL/PGH supports two trigger types, **internal trigger** and **external trigger.** The external trigger comes from **ExtTrg, CN3 pin 17**. There are two types of internal triggers, **software trigger** and **pacer trigge**r. More detailed information is given in section 2.4.8.

2.3.5 JP5 : Interrupt Level Selection



The interrupt channel **<u>can not be shared.</u>** The OME-A-822 software driver can support 8 different cards in one system but only **2 of these cards** can use the interrupt transfer function.

2.3.6 JP6 : User Timer/Counter Clock Input Selection



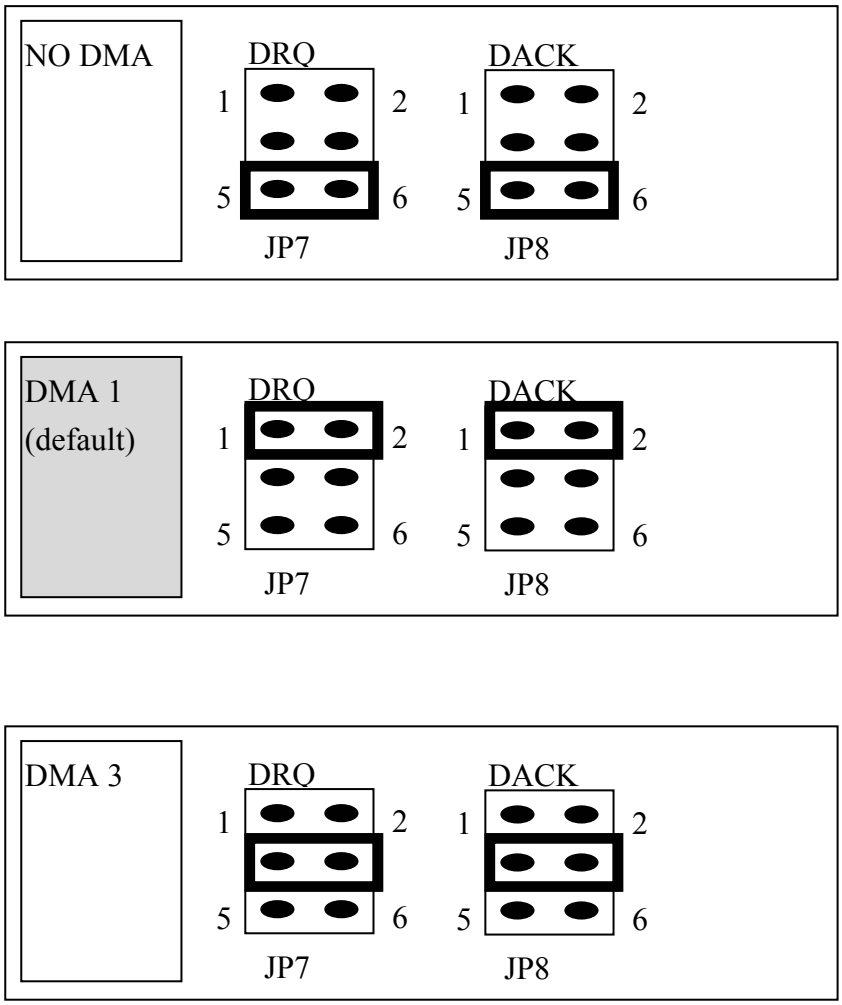
The OME-A-822PGL/PGH has 3 independent 16 bit timer/counters. The cascaded counter1 and counter2 are used as **a pacer timer**. Counter0 can be used as a user programmable timer/counter. The user programmable timer/counter can be set to **2M internal clock** or **external clock ExtCLK, CN3 pin 37**. The block diagram is given in section 2.6. The clock source must be very **stable.** Using the 2M internal clock is strongly suggested.

The OME-A-822PGL/PGH software driver uses counter0 as a machine independent timer. If users program calls the **A-822_Delay()** subroutine, counter0 will be programmed as a machine independent timer. More detailed information is provided in section 2.6.

NOTE : if you use A-822_Delay(), the JP6 jumper must be set to internal 2M clock.

2.3.7 JP7 : DMA DACK Selection,

JP8 : DMA DRQ Selection



The DMA channel can not shared. The OME-A-822 software driver can support 8 different boards in one PC based system, but only **two of these boards** can use the DMA transfer function.

2.4 I/O Register Address

The OME-A-822PGL/PGH occupies 16 consecutive PC I/O addresses. The following table lists the registers and their locations.

Address	Read	Write
Base+0	8254 Counter 0	8254 Counter 0
Base+1	8254 Counter 1	8254 Counter 1
Base+2	8254 Counter 2	8254 Counter 2
Base+3	Reserved	8254 Counter Control
Base+4	A/D Low Byte	D/A Channel 0 Low Byte
Base+5	A/D High Byte	D/A Channel 0 High Byte
Base+6	DI Low Byte	D/A Channel 1 Low Byte
Base+7	DI High Byte	D/A Channel 1 High Byte
Base+8	Reserved	A/D Clear Interrupt Request
Base+9	Reserved	A/D Gain Control
Base+A	Reserved	A/D Multiplexer Control
Base+B	Reserved	A/D Mode Control
Base+C	Reserved	A/D Software Trigger Control
Base+D	Reserved	DO Low Byte
Base+E	Reserved	DO High Byte
Base+F	Reserved	Reserved

2.4.1 8254 Counter

The 8254 Programmable timer/counter has 4 registers from Base+0 through Base+3. For detailed programming information on the 8254 , please refer to Intel‘s “Microsystem Components Handbook”.

Address	Read	Write
Base+0	8254 Counter 0	8254 Counter 0
Base+1	8254 Counter 1	8254 Counter 1
Base+2	8254 Counter 2	8254 Counter 2
Base+3	Reserved	8254 Counter Control

2.4.2 A/D Input Buffer Register

(READ) Base+4 : A/D Low Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

(READ) Base+5 : A/D High Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	READY	D11	D10	D9	D8

A/D 12 bit data : D11…..D0, D11=MSB, D0=LSB

READY =1 : A/D 12 bit data not ready

=0 : A/D 12 bit data is ready

The low 8 bit A/D data is stored in address BASE+4 and the high 4 bit data is stored in address BASE+5. The READY bit is used as an indicator for the A/D conversion. **When an A/D conversion is completed, the READY bit will clear to zero.**

2.4.3 D/A Output Latch Register

(WRITE) Base+4 : Channel 1 D/A Low Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

(WRITE) Base+5 :Channel 1 D/A High Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	D11	D10	D9	D8

(WRITE) Base+6 : Channel 2 D/A Low Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

(WRITE) Base+7 :Channel 2 D/A High Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	D11	D10	D9	D8

D/A 12 bit output data: D11..D0, D11=MSB, D0=LSB, X=don‘t care

The D/A converter will convert the 12 bit digital data to an analog output. The lower 8 bits of **D/A channel 1** are stored in the address BASE+4 and the high 4 bits are stored in the address BASE+5. The address BASE+6 and BASE+7 store the 12 bit data for **D/A channel 2**. The D/A output latch registers are designed with a **“double buffered”** structure, so the analog output latch registers will not update until the high 4 bit digital data are written. If the user sends the high 4 bit data first, the D/A 12 bit output latch registers will update at once. So the lower 8 bits will be the previous data latched in the register. **This action will cause an error on the D/A output voltage**. **The user must send the low 8 bits first and then send the high 4 bits to update the 12 bit D/A output** latch register.

NOTE : Send the low 8 bits first, then send the high 4 bits.

2.4.4 D/I Input Buffer Register

(READ) Base+6 : D/I Input Buffer Low Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

(READ) Base+7 : D/I Input Buffer High Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D15	D14	D13	D12	D11	D10	D9	D8

D/I 16 bits input data : D15..D0, D15=MSB, D0=LSB

The OME-A-822PGL/PGH provides 16 TTL compatible digital inputs. The low 8 bits are stored in the address BASE+6. The high 8 bits are stored in address BASE+7.

2.4.5 Clear Interrupt Request

(WRITE) Base+8 : Clear Interrupt Request Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	X	X	X

X=don‘t care, XXXXXXXX=any 8 bits data is validate

If the OME-A-822PGL/PGH is used in the interrupt transfer mode, an on-board hardware status bit will be set after each A/D conversion. This bit must be **cleared by software** before the next hardware interrupt. Writing any value to address BASE+8 will clear this hardware bit and the hardware will generate another interrupt when next A/D conversion is completed.

2.4.6 A/D Gain Control Register

(WRITE) Base+9 : A/D Gain Control Register Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	GAIN3	GAIN2	GAIN1	GAIN0

The only difference between the OME-A-822PGL and OME-A-822PGH is the **GAIN** control function. The **OME-A-822PGL provides gains of 1/2/4/8** and the **OME-A-822PGH provides gains of 1/10/100/1000.** The gain control register control the gain of the A/D input signal. Bipolar/Unipolar will affect the gain factor.
It is important to select the correct gain-control-code according to Bipolar/Unipolar input.

NOTE : If the gain control code is changed, the hardware needs an extra delay for the gain settling time. The gain settling time is different for the different gain control codes. **The software driver does not take care the gain settling time, so the user needs to add the delay .** If the application program will run on different machines, the user needs to implement a machine independent timer. The software driver, **A-822_delay(),** is designed for this purpose. If this subroutine is used, then counter2 as described in sec 2.6 is reserved by the software driver to implement the machine independent timer.

OME-A-822PGL GAIN CONTROL CODE TABLE

BI/UNI	Settling Time	GAIN	Input Range	GAIN3	GAIN2	GAIN1	GAIN0
BI	23 us	1	+/- 5V	0	0	0	0
BI	23 us	2	+/- 2.5V	0	0	0	1
BI	25 us	4	+/- 1.25V	0	0	1	0
BI	28 us	8	+/- 0.0625V	0	0	1	1
UNI	23 us	1	0V to 10V	0	1	0	0
UNI	23 us	2	0V to 5V	0	1	0	1
UNI	25 us	4	0V to 2.5V	0	1	1	0
UNI	28 us	8	0V to 1.25V	0	1	1	1
BI	23 us	0.5	+/- 10V	1	0	0	0

BI=Bipolar, UNI=Unipolar, X=don‘t care, N/A=not available

OME-A-822PGH GAIN CONTROL CODE TABLE

BI/UN	Settling Time	GAIN	Input Range	GAIN3	GAIN2	GAIN1	GAIN0
BI	23 us	1	+/- 5V	0	0	0	0
BI	28 us	10	+/- 0.5V	0	0	0	1
BI	140 us	100	+/- 0.05V	0	0	1	0
BI	1300 us	1000	+/- 0.005V	0	0	1	1
UNI	23 us	1	0 to 10V	0	1	0	0
UNI	28 us	10	0 to 1V	0	1	0	1
UNI	140 us	100	0 to 0.1V	0	1	1	0
UNI	1300 us	1000	0 to 0.01V	0	1	1	1
BI	23 us	0.5	+/- 10V	1	0	0	0
BI	28 us	5	+/- 1V	1	0	0	1
BI	140 us	50	+/- 0.1V	1	0	1	0
BI	1300 us	500	+/- 0.01V	1	0	1	1

BI=Bipolar, UNI=Unipolar, X=don‘t care, N/A=not available

2.4.7 A/D Multiplex Control Register

(WRITE) Base+A : A/D Multilexer Control Register Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	D3	D2	D1	D0

A/D input channel selection data = 4 bits : D3..D0, D3=MSB, D0=LSB, X=don‘t care

Single-ended mode : D3..D0

Differential mode : D2..D0, D3=don’t care

The OME-A-822PGL/PGH provides 16 single-ended or 8 differential analog input signals. In single-ended mode, D3..D0 selects the active channel. In differential mode, D2..D0 selects the active channel and (D3 has no affect).

NOTE: The settling time of the multiplexer depends on the resistance.of the input sources.

source resistance = about 0.1K ohm → settling time = about 3 us.

source resistance = about 1K ohm → settling time = about 5 us.

source resistance = about 10K ohm → settling time = about 10 us.

source resistance = about 100K ohm → settling time = about 100 us.

2.4.8 A/D Mode Control Register

(WRITE) Base+B : A/D Mode Control Register Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	D2	D1	D0

X=don‘t care

JP4 Select Internal Trigger							
Mode Select			Trigger Type		Transfer Type		
D2	D1	D0	Software Trig	Pacer Trig	Software	Interrupt	DMA
0	0	0	X	X	X	X	X
0	0	1	Select	X	Select	X	X
0	1	0	X	Select	X	X	Select
1	1	0	X	Select	Select	Select	X

X=disable

JP4 Select External Trigger						
Mode Select			Trigger Type	Transfer Type		
D2	D1	D0	External Trigger	Software	Interrupt	DMA
0	0	0	X	X	X	X
0	0	1	X	X	X	X
0	1	0	Select	X	X	Select
1	1	0	Select	Select	Select	X

The A/D conversion can be divided into 2 stages, **trigger stage and transfer stage**. The trigger stage will generate a trigger signal to the A/D converter and the transfer stage will transfer the result to the CPU.

The trigger method may be **internal trigger** or **external trigger.** The internal trigger can be **software trigger** or **pacer trigger. The software trigger is simple to use but does not control the sampling rate very precisely.** In the software trigger mode, the program issues a software trigger command (sec 2.4.9) to initiate the A/D conversion. The program then must poll the A/D status bit until the ready bit is 0(sec 2.4.2).

The pacer trigger can control the sample rate very precisely. In the pacer trigger mode, the pacer timer (sec 2.6) will generate periodic trigger signals to the A/D converter. The converted data can be transferred to the CPU by polling or interrupt or by DMA transfer.

The software driver provides three data transfer methods, **polling, interrupt and DMA.** The polling subroutine, A-822_AD_PollingVar() or A-822_AD_PollingArray(), set the A/D mode control register to **0x01.** This control word enables software trigger and polling transfer. The interrupt subroutine, A-822_AD_INT_START(…), sets the A/D mode control mode register to **ox06.** This control word enables pacer trigger and interrupt transfer. The DMA subroutine, A-822_AD_DMA_START(…), sets the A/D mode control register to **0x02**. This control word means pacer trigger and DMA transfer.

Please refer to sec. 2.7 for detailed information.

2.4.9 A/D Software Trigger Control Register

(WRITE) Base+C : A/D Software Trigger Control Register

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	X	X	X

X=don‘t care, XXXXXXXX=any 8 bits data is validate

The A/D converter can be triggered by software trigger or pacer trigger. The details are given in sec. 2.4.8 and sec. 2.7. Writing any value to address BASE+C will generate a trigger pulse to the A/D converter and initiate an A/D conversion. The address BASE+5 offers a ready bit to indicate an A/D conversion is completed.

The software driver uses this control word to detect the OME-A-822PGL/PGH hardware board. **The software initiates a software trigger and checks the ready bit** . If the ready bit can not cleared to zero in a fixed time, the software driver will return a error message. If there is an I/O BASE address error, the ready bit will not be cleared to zero. The software driver, **A-822_CheckAddress()**, uses this method to detect the I/O BASE address setting

2.4.10 D/O Output Latch Register

(WRITE) Base+D : D/O Output Latch Low Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

(WRITE) Base+E : D/O Output Latch High Byte Data Format

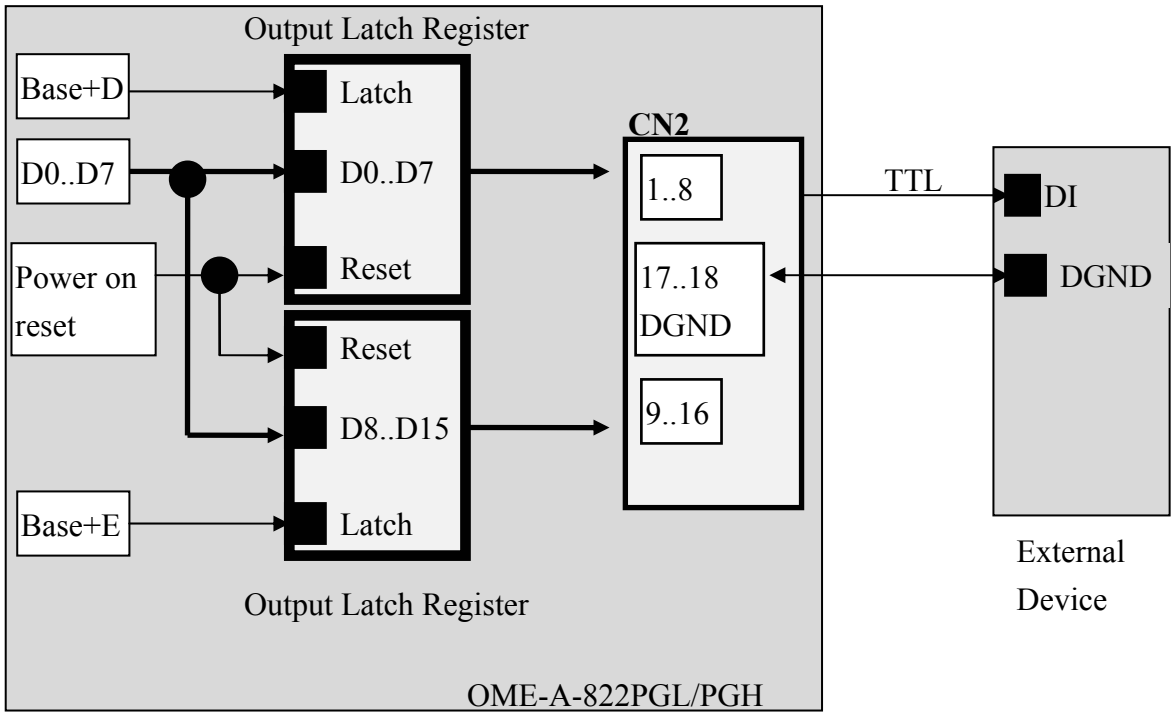
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D15	D14	D13	D12	D11	D10	D9	D8

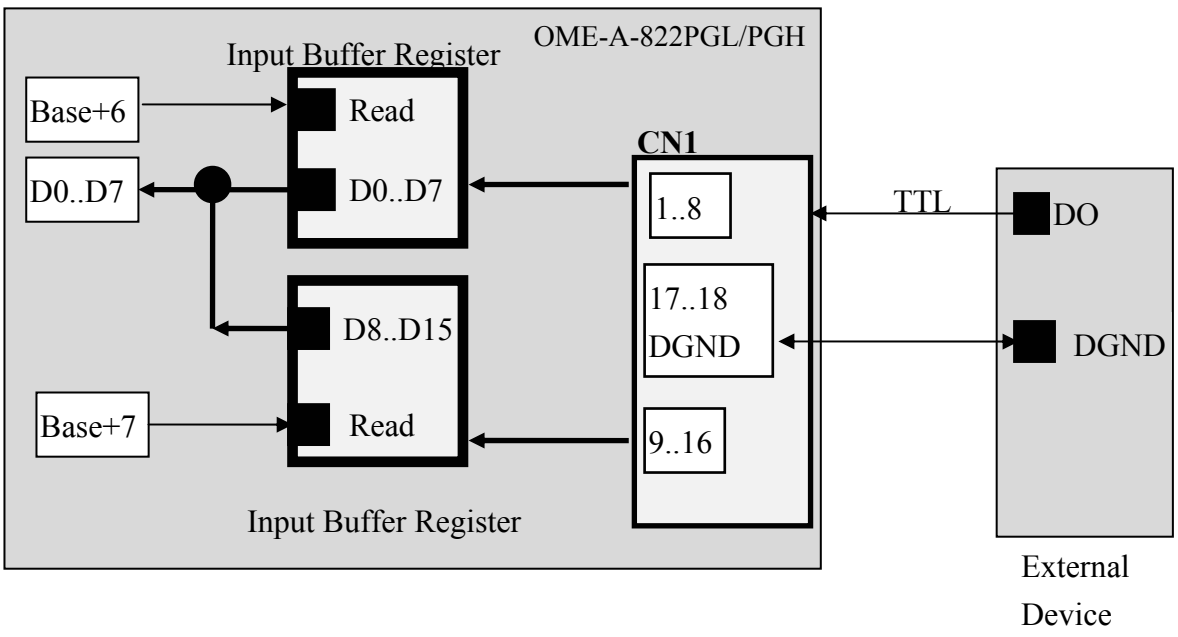
D/O 16 bits output data : D15..D0, D15=MSB, D0=LSB

The OME-A-822PGL/PGH provides 16 TTL compatible digital outputs. The lower 8 bits are stored in address **BASE+D.** The high 8 bits are stored in address **BASE+E**

2.5 Digital I/O

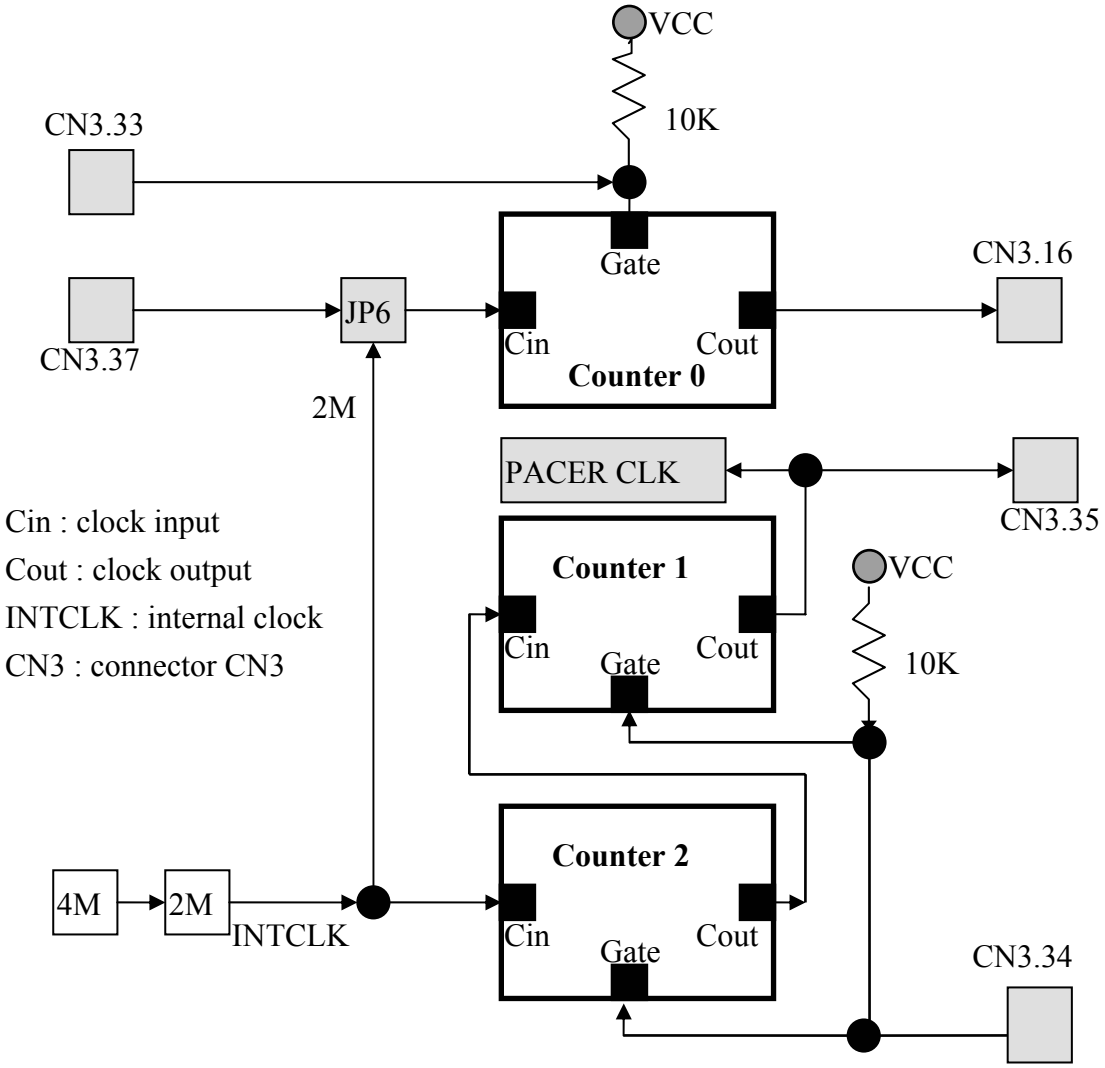
The OME-A-822PGL/PGH provides 16 digital input channels and 16 digital output channels. All levels are TTL compatible. The connection diagram and block diagram are given below:





2.6 8254 Timer/Counter

The 8254 Programmable timer/counter has 4 registers from Base+0 through Base+3. For detailed programming information about the 8254 , please refer to Intel‘s “Microsystem Components Handbook”.The block diagram is shown below.



The counter0, counter1 and counter2 are all 16 bit counters. Counter 1 and counter 2 are cascaded as a 32 bit timer. This 32 bit timer is used as a **pacer timer**. **The software driver, A-822_Delay(), uses counter 0 to implement a machine independent timer for settling time delay (sec. 2.4.6 and sec. 2.4.7).** If A-822_Delay() is not used, counter0 can be used as a general purpose timer/counter.

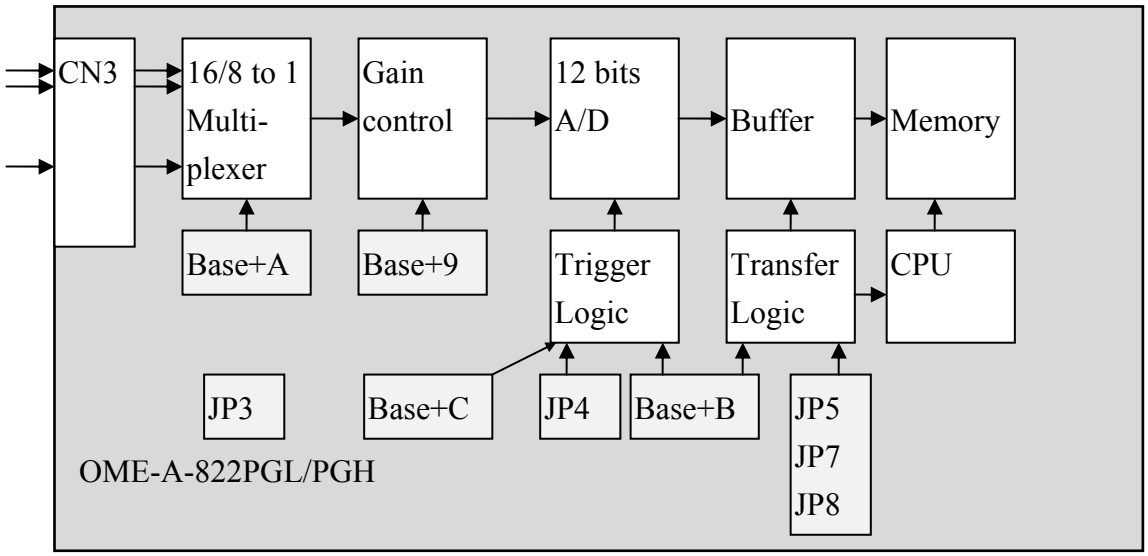
NOTE : When using A-822_Delay() to implement a machine independent timer, the JP6 jumper must be set to internal 2M clock.

2.7 A/D Conversion

This section explains how to perform A/D conversions. The A/D conversion can be triggered 3 ways, **by software trigger, by pacer trigger or by external trigger** to the A/D converter. At the end of A/D conversion, it is possible to transfer data by 3 ways, those are **polling , interrupt and DMA.** Before using the A/D conversion functions, the user should be aware of the following issues:

- A/D data register BASE+4/BASE+5 stores the A/D conversion data **(sec. 2.4.2)**
- A/D gain control register BASE+9 selects the gain **(sec. 2.4.6)**
- A/D multiplexer control register BASE+A selects the analog input channel **(sec. 2.4.7)**
- A/D mode control register BASE+B selects the trigger type and transfer type **(sec. 2.4.8)**
- A/D software trigger control register is BASE+C **(sec. 2.4.9)**
- JP3 selects single-ended or differential input **(sec. 2.3.3)**
- JP4 selects internal/external trigger **(sec. 2.3.4)**
- JP5 selects the IRQ level **(sec. 2.3.5)**
- JP6 selects the internal/external clock for counter0 **(sec. 2.3.6)**
- JP7 and JP8 selects the DMA channel **(sec. 2.3.7)**
- **There are 3 trigger types : software, pacer, external trigger (sec. 2.4.8)**
- **There are 3 transfer types : polling, interrupt, DMA (sec. 2.4.8)**

The block diagram is given below:



2.7.1 A/D conversion flow

Before using the A/D converter, the user should configure the following hardware settings:

1. select single-ended or differential input (JP3) **(refer to Sec. 2.9 first)**
2. select internal trigger or external trigger (JP4)
3. select IRQ level if needed (JP5)
4. select DMA channel if needed (JP7,JP8)
5. select internal clock or external clock for counter0 if needed (JP6)

The user must decide which A/D conversion mode will be used. The software driver supports three different modes: **polling, interrupt and DMA.** The polling mode (sec. 2.4.9) is the simplest but most limited. The software driver should be used for interrupt or DMA mode.

The analog input signals come from CN3. These signals may be single-ended or differential and must match the setting of JP3.

The multiplexer can select 16 single-ended or 8 differential signals into the gain control module. **The settling time of multiplexer depends on the source resistance.** Because the software **doesn't account for the settling time**, **the user should provide sufficient delay when switching channels. (sec. 2.4.7)**

The gain control module also requires settling time if the gain control code is changed. Since the software **doesn't account for settling time**, **the user should provide sufficient delay if the gain control code is changed. (sec. 2.4.6)**

The software driver provides **a machine independent timer, A-822_Delay()**, for settling time delay. This subroutine assumes that the JP6 jumper is set to the internal 2M clock and uses counter0 to implement a machine independent timer. If A-822_Delay() is used, counter0 will be reserved and can not be used as a user programmable timer/counter.

The A/D converter needs a trigger signal to start an A/D conversion cycle. The OME-A-822PGL/PGH supports three trigger modes, **software, pacer and external trigger**. The result of the A/D conversion can be transferred into the PC memory by three modes: **polling, interrupt and DMA**..

2.7.2 A/D Conversion Trigger Modes

OME-A-822PGL/PGH supports three trigger modes.

1 : Software Trigger :

Write any value to the A/D software trigger control register, BASE+A, to initiate an A/D conversion cycle. This mode is very simple but it is very difficult to achieve a precise sample rate.

2 : Pacer Trigger Mode :

The block diagram of the pacer timer is shown in section 2.6. The pacer timer can provide a very precise sample rate.

3 : External Trigger Mode :

When a rising edge of an external trigger signal is applied, an A/D conversion will be performed. The external trigger source comes from pin 17 of CN3.

2.7.3 A/D Transfer Modes

OME-A-822PGL/PGH supports three transfer modes.

1 : polling transfer :

This mode can be used with all trigger modes. More detailed information is given in section 2.4.8. The software scans the A/D high byte data register, BASE+5, until READY_BIT=0.The low byte data is available in BASE+4.

2 : interrupt transfer :

This mode can be used with the pacer trigger or external trigger. More detailed information is given in section 2.4.8.The user can set the IRQ level by adjusting jumper JP5. A hardware interrupt signal is sent to the PC when an A/D conversion is completed.

3 : DMA transfer :

This mode can be used with the pacer trigger or external trigger. More detailed information is given in section 2.4.8. The user can set the DMA channel by adjusting jumpers JP7 and JP8. Two hardware DMA requests signals are sent sequentially to the PC when an A/D conversion is completed. The single mode transfer of the 8237 is suggested.

2.7.4 Using software trigger and polling transfer

If the user needs to control the A/D converter without the A-822 software driver, software trigger and polling transfer is suggested. The program steps are listed below:

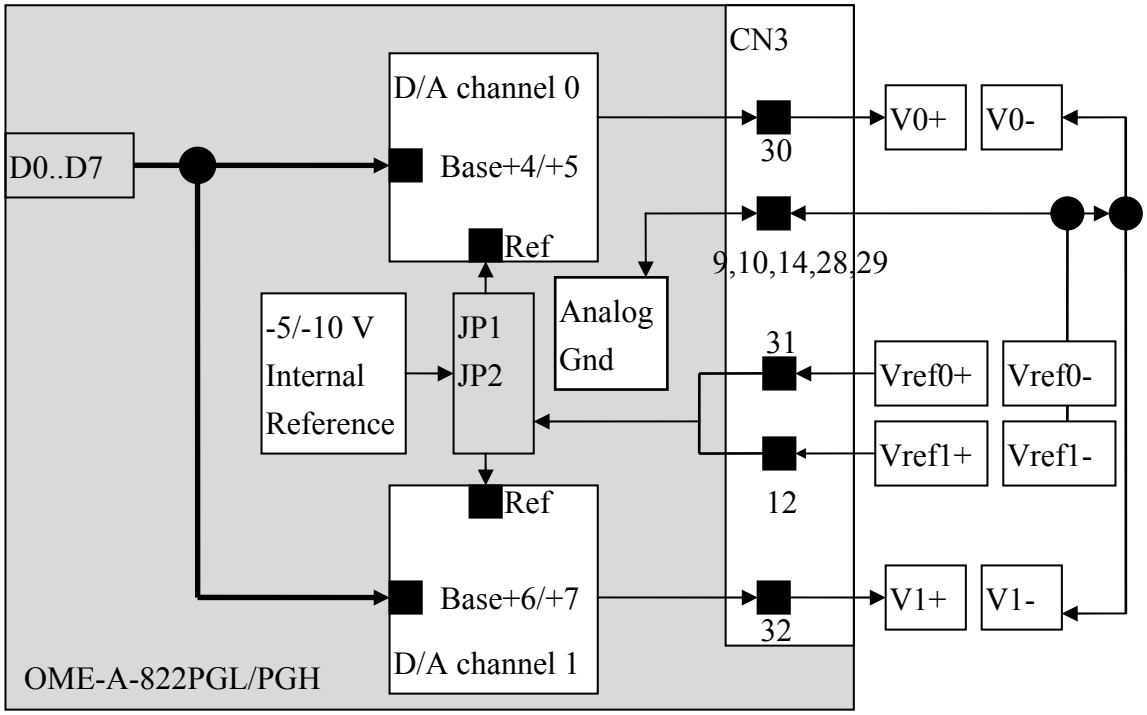
1. send 0x01 to the A/D mode control register (software trigger + polling transfer) **(refer to Sec. 2.4.8)**
2. send channel number to the multiplexer control register **(refer to Sec.** 2.4.7)
3. send the gain control code value to the gain control register **(refer to Sec 2.4.6)**
4. delay the settling time **(refer to Sec. 2.4.6 and Sec. 2.4.7)**
5. send any value to the software trigger control register to generate a software trigger signal **(refer to Sec. 2.4.9)**
6. scan the READY bit of the A/D high byte data until READY=0 **(refer to Sec. 2.4.2)**
7. read the 12 bit A/D data **(refer to Sec. 2.4.2)**
8. convert the 12 bit binary data to a floating point value

2.8 D/A Conversion

The OME-A-822PGL/PGH provides two 12 bit D/A converters. Before using the D/A converter function, you should address the following items:

- D/A output register, BASE+4/BASE+5/BASE+6/BASE+7, (sec. 2.4.3)
- JP1 jumper set to internal reference voltage -5V or -10V (sec. 2.3.1)
- JP2 jumper set to internal or external reference voltage (sec. 2.3.2)
- If JP2 is set to internal and JP1 is set to -5V, the D/A output range is 0 to 5V
- If JP2 is set to internal and JP1 is set to -10V, the D/A output range is 0 to 10V
- If JP2 is set to external, the external reference voltage can be AC/DC +/- 10V

The block diagram is given below:



NOTE : The D/A output latch registers use a "double buffer" structure. **The user must send the low byte data first, then send the high byte data**. If the user only sends the high byte, the low byte data will be the previous value.

2.9 Analog Input Signal Connection

The OME-A-822 can measure signals in the single-ended or differential mode. In the differential mode each channel has a unique signal HIGH and signal LOW connection. In the single-ended mode all channels have a unique signal HIGH connection but share a common LOW or ground connection. Differential connections are very useful for low level signals (millivolt), since they better reject electrical noise that can affect the quality of the measurement. A differential connection is also necessary when a common ground is unacceptable. The benefit of using a single-ended connection is that twice the number of channels is available. In general, a single-ended connection is often a good choice when working with higher level signals (5V or 10V for example), especially if the signal is coming from an isolated device such as a signal conditioner. Several different types of wiring diagrams are discussed below.

Figure 1-A shows a differential connection to a grounded source. If the source is grounded, making a second connection to the card's ground could cause a ground loop resulting in erroneous data. **It is important to note that the maximum common mode voltage between the input source and AGND is 70Vp-p. If the card is connected to a source with a common mode voltage greater than 70Vp-p, the input multiplexer will be permanently damaged!** When measuring common mode voltage, it is best to use an oscilloscope rather than a multi-meter.

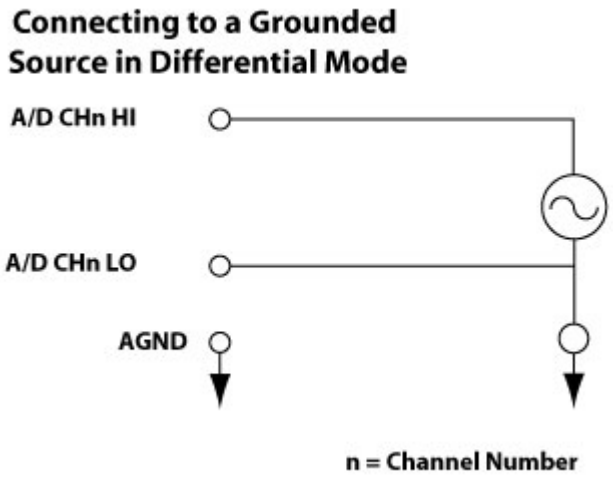
Figure 1-B shows a differential connection to a floating source. In such cases a connection should be made between the low channel input and analog ground.

Figure 2 shows connection of multiple sources in single-ended mode. This connection assumes creating one common ground will not cause a problem. This is normally the case when connecting to devices that are isolated or floating.

Figure 3 demonstrates how to connect bridge transducers. Bridge transducers include strain gauges, load cells and certain type of pressure transducers. The diagram assumes that there is a single external power supply providing power to the bridge. Each bridge is connected to a differential channel. No connection is made between channel low and analog ground. A connection should be made between analog ground and the negative of the power supply. An isolated power supply is strongly suggested.

Figure 4 demonstrates how to connect a 4-20mA current loop. Since the card reads voltages, the current is converted to voltage by passing it through a shunt resistor. By Ohms law (V=IR), when using a 250Ω resistor, 4 mA will be converted to 1V and 20mA to 5V. If the source is linear, the output voltage range will also be linear.

Figure 1-A



If the source is grounded, a second ground connection on the card could result in a ground loop.

Figure 1-B

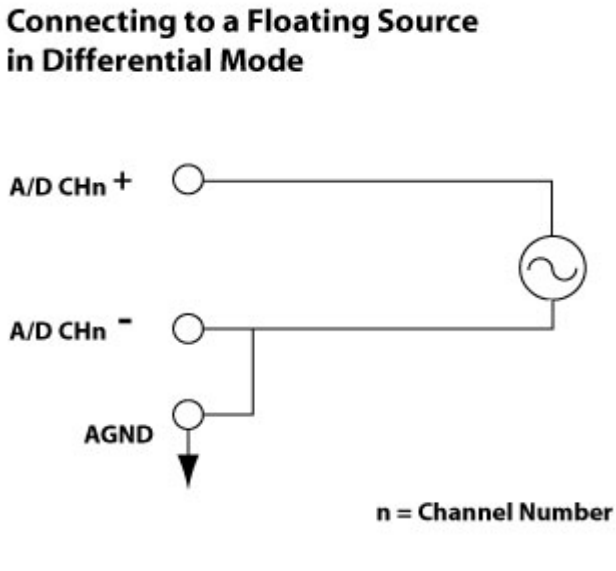


Figure 2

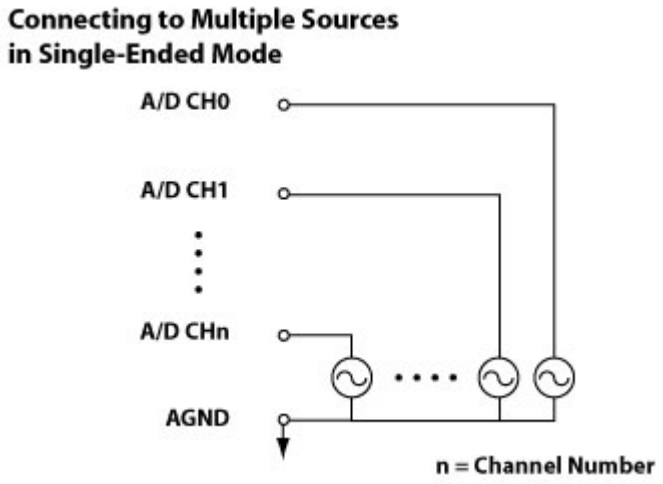


Figure 3

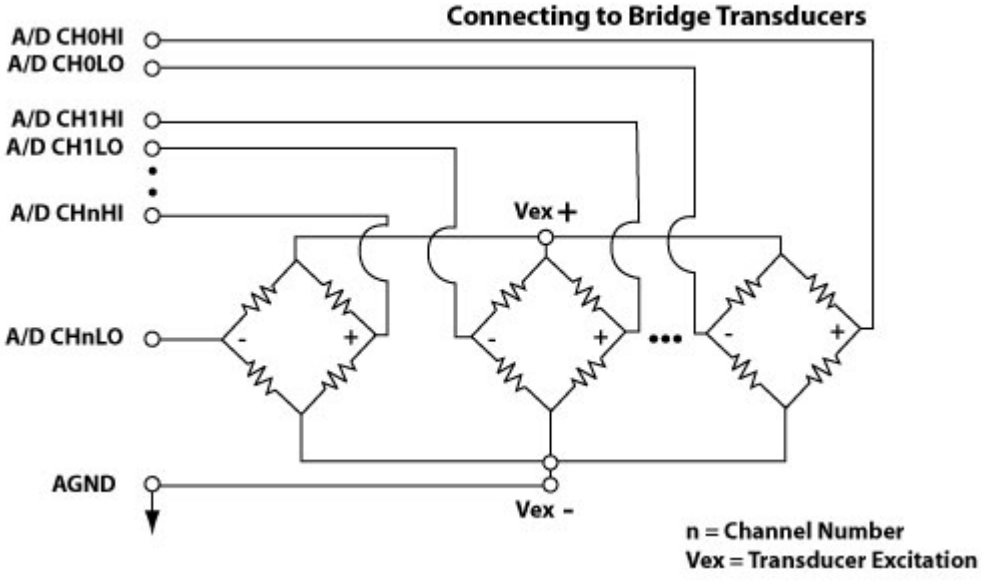
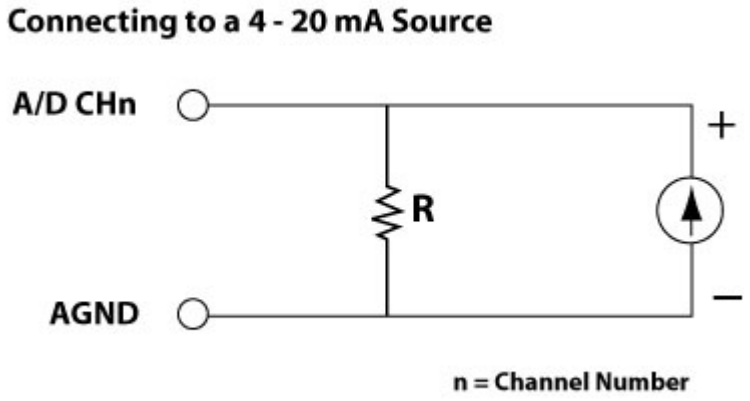


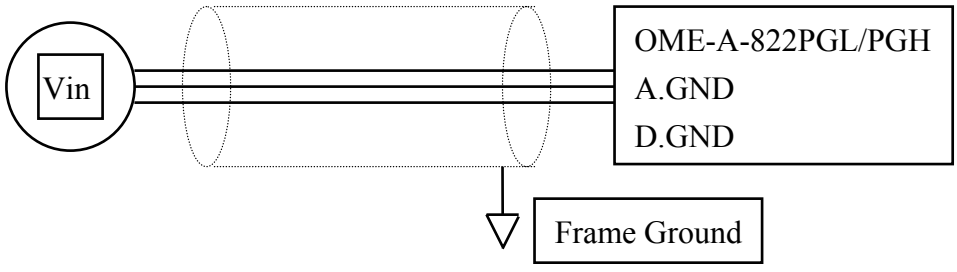
Figure 4



R is a shunt resistor. A 250Ω shunt resistor converts 4-20mA to 1-5Vdc.

Signal Shielding

- The signal shielding is the same for the connections shown in Figure 1 to Figure 4
- Use a single connection to **frame ground (not A.GND or D.GND)**



2.10 Using OME-DB-8225 CJC Output

The OME-DB-8225 daughter board contains built-in cold junction compensation (CJC) circuitry that provides a 10mV per Deg C output. With 0.0 Volts @ -273 Deg C. The OME-A-822 should be protected from drafts and direct sunlight in order to accurately reflect room temperature.

CJC Calibration:

1. Connect the OME-A-822PGL/PGH to the OME-DB-8225 CN1
2. Set the OME-A-822PGL/PGH to single-ended Mode
3. Set the JP1 jumper to 1-2 and the JP2 jumper to 2-3 (single-ended mode)
4. Read the temperature from a digital thermometer placed near D1/D2(See the OME-DB-8225 Layout) .
5. Read OME-A-822PGL/PGH analog input channel 0 (single-ended Channel 0)
6. Adjust VR1 until a stable reading of 10mV per deg C is attained .

For example, when the ambient temperature is 24 deg C. the reading value of CJC will be 2.97V

(273 deg c +24 deg c) X 10 mV/deg c = 2.97V

You will need an A/D channel for the CJC calibration. AI0 is reserved for CJC calibration when used in single-ended mode and CH0-HI & CH0-LO is reserved for the differential mode. differential mode is recommended when working with thermocouples.

3. Connector

The OME-A-822PGL/PGH provides three connectors. Connector 1, **CN1 contains the 16 digital inputs.** Connector 2, **CN2, contains the 16 digital outputs**. Connector 3, **CN3, contains the analog inputs, analog outputs and timer/counter I/O**.

3.1 CN1/CN2/CN3 Pin Assignment

CN1 : Digital Input Pin Assignment.

Pin Number	Description	Pin Number	Description
1	Digital Input 0/TTL	2	Digital Input 1/TTL
3	Digital Input 2/TTL	4	Digital Input 3/TTL
5	Digital Input 4/TTL	6	Digital Input 5/TTL
7	Digital Input 6/TTL	8	Digital Input 7/TTL
9	Digital Input 8/TTL	10	Digital Input 9/TTL
11	Digital Input 10/TTL	12	Digital Input 11/TTL
13	Digital Input 12/TTL	14	Digital Input 13/TTL
15	Digital Input 14/TTL	16	Digital Input 15/TTL
17	GND	18	GND
19	+5V Output	20	+12V Output

CN2 : Digital Output Pin Assignment.

Pin Number	Description	Pin Number	Description
1	Digital Output 0/TTL	2	Digital Output 1/TTL
3	Digital Output 2/TTL	4	Digital Output 3/TTL
5	Digital Output 4/TTL	6	Digital Output 5/TTL
7	Digital Output 6/TTL	8	Digital Output 7/TTL
9	Digital Output 8/TTL	10	Digital Output 9/TTL
11	Digital Output 10/TTL	12	Digital Output 11/TTL
13	Digital Output 12/TTL	14	Digital Output 13TTL
15	Digital Output 14/TTL	16	Digital Output 15/TTL
17	GND	18	GND
19	+5V Output	20	+12 OutputV

SINGLE-ENDED SIGNAL MODE

CN3 : Analog input, Analog output and Timer/Counter Pin Assignment.

Pin Number	Description	Pin Number	Description
1	Analog Input 0/+	20	Analog Input 8/+
2	Analog Input 1/+	21	Analog Input 9/+
3	Analog Input 2/+	22	Analog Input 10/+
4	Analog Input 3/+	23	Analog Input 11/+
5	Analog Input 4/+	24	Analog Input 12/+
6	Analog Input 5/+	25	Analog Input 13/+
7	Analog Input 6/+	26	Analog Input 14/+
8	Analog Input 7/+	27	Analog Input 15/+
9	Analog GND	28	Analog GND
10	Analog GND	29	Analog GND
11	D/A internal -5V/-10V voltage reference	30	D/A channel 0 analog voltage output
12	D/A channel 1 external voltage reference input	31	D/A channel 0 external voltage reference input
13	+12V Output	32	D/A channel 1 analog voltage output
14	PCB analog GND	33	User timer/counter‘s GATE control input
15	PCB digital GND	34	Timer/counter 1&2 GATE control input
16	User timer/counter output	35	Timer/counter 1 output
17	External trigger source input/TTL	36	Reserved
18	Reserved	37	User timer/counter external clock input (internal=2M)
19	+5V Output	XXXXXXX	This pin not available

DIFFERENTIAL SIGNALS

CN3 : Analog input, Analog output and Timer/Counter Pin Assignment.

Pin Number	Description	Pin Number	Description
1	Analog Input 0/+	20	Analog Input 0/-
2	Analog Input 1/+	21	Analog Input 1/-
3	Analog Input 2/+	22	Analog Input 2/-
4	Analog Input 3/+	23	Analog Input 3/-
5	Analog Input 4/+	24	Analog Input 4/-
6	Analog Input 5/+	25	Analog Input 5/-
7	Analog Input 6/+	26	Analog Input 6/-
8	Analog Input 7/+	27	Analog Input 7/-
9	Analog GND	28	Analog GND
10	Analog GND	29	Analog GND
11	D/A internal -5V/-10V voltage reference output	30	D/A channel 0 analog voltage output
12	D/A channel 1 external voltage reference input	31	D/A channel 0 external voltage reference input
13	+12V Output	32	D/A channel 1 analog voltage output
14	Analog GND	33	User timer/counter GATE control input
15	Digital GND output	34	Timer/counter 1&2 GATE control input
16	User timer/counter output	35	Timer/counter 1 output
17	External trigger source input/TTL	36	Reserved
18	Reserved	37	User timer/counter external clock input (internal=2M)
19	+5V output	XXXXXXX	This pin not available

3.2 Daughter Board

The OME-A-822PGL/PGH can be connected with many different daughter boards. The daughter boards are described below:

3.2.1 OME-DB-8225

The OME-DB-8225 provides an **on-board CJC**(Cold Junction Compensation) circuit for thermocouple measurement and a **terminal block** for easy signal connection. The CJC is connected to A/D channel_0. The OME-A-822PGL/PGH can connect to an OME-DB-8225 through a 37-pin D-sub connector on CN3.

3.2.2 OME-DB-37

The OME-DB-37 is a **general purpose** 37-pin screw terminal board. It connects to a 37-pin D-sub connector.

3.2.3 OME-DB-16P

The OME-DB-16P is a **16 channel isolated digital input** board. The OME-A-822PGL/PGH provides 16 channels of non-isolated TTL-compatible digital inputs via the CN1 connector. If used with the OME-DB-16P, the OME-A-822PGL/PGH can provide 16 channels of isolated digital input. Isolation can protect the computer if abnormal or excessive input signals are received.

3.2.4 OME-DB-16R

The OME-DB-16R provides **16 SPDT relay outputs.** The OME-A-822PGL/PGH provides 16 TTL-compatible digital outputs via CN2. If connecting to the OME-DB-16R, the OME-A-822PGL/PGH can provide 16 relay outputs to control external devices.

4. Calibration

The OME-A-822PGL/PGH is factory calibrated for optimum performance. Recalibration is suggested for high vibration environments. The following items are required for calibrating the OME-A-822PGL/PGH.

- One 6 digit multimeter
- One stable voltage source (4.9988V)
- Diagnostic program : this program included with the OME-A822PGL/PGH.

4.1 Description of Variable Resistors

There are seven variable resistors(VRs) on the OME-A-822PGL/PGH used for calibration, they are described below.

VR Num.	Description
VR1	A/D offset adjustment
VR2	A/D gain adjustment
VR3	D/A channel 0 gain adjustment
VR4	D/A channel 1 gain adjustment
VR5	D/A reference voltage adjustment
VR6	A/D unipolar offset adjustment
VR7	A/D programmable amplifier offset adjustment

4.2 D/A Calibration

1. Run the A82XDIAG.EXE program
2. Press the “Right Arrow Key” to select “CALIBRATION”.
3. Press the “Down Arrow Key” to select “G. D/A REFERENCE”.
4. Press the “Enter Key”
5. Connect VREF, pin 11 of CN3, to a DVM (Digital Volt Meter)
6. Adjust VR5 until the DVM=4.9988V
7. Press the “ESC Key”
8. Select and Execute “A. D/A REFERENCE 1” item
9. Connect D/A channel 0, pin 30 of CN3, to the DVM
10. Adjust VR3 until the DVM=4.9988V
11. Press the “ESC Key”
12. Select and Execute “B. D/A REFERENCE2” item
13. Connect D/A channel 1, pin 32 of CN3, to the DVM
14. Adjust VR4 until the DVM=4.9988V

4.3 A/D Calibration

1. Run the A82XDIAG.EXE
2. Press “Right Arrow Key” to select “CALIBRATION”
3. Press the “Down Arrow Key” to select “C. A/D REFERENCE” item.
4. Press the “Enter Key”
5. Input a stable 4.9988V to A/D channel 0, pin 1 of CN3
6. Adjust VR2 until the A/D data shown on the screen is between 4094 to 4095
7. Press the “ESC Key”
8. Select and Execute the “D. A/D OFFSET” item
9. Input a stable 0V to A/D channel 0, pin1 of CN3
10. Adjust VR1 until the A/D data shown on the screen is between 2048 to 2049
11. Press the “ESC Key”
12. Repeat step_3 to step_11 until there is no need to adjust VR2,VR1
13. Select and Execute “E. PGA OFFSET” item
14. Input a stable 0V to A/D channel 0, pin 1 of CN3
15. Adjust VR7 until the A/D data shown in screen between 2048 to 2049
16. Press “ESC Key”
17. Select and Execute “F. PGA REFERENCE” item
18. Input a stable 0V to A/D channel 0 , pin1 of CN3
19. Adjust VR6 until the A/D data shown on screen is between 0 and 1

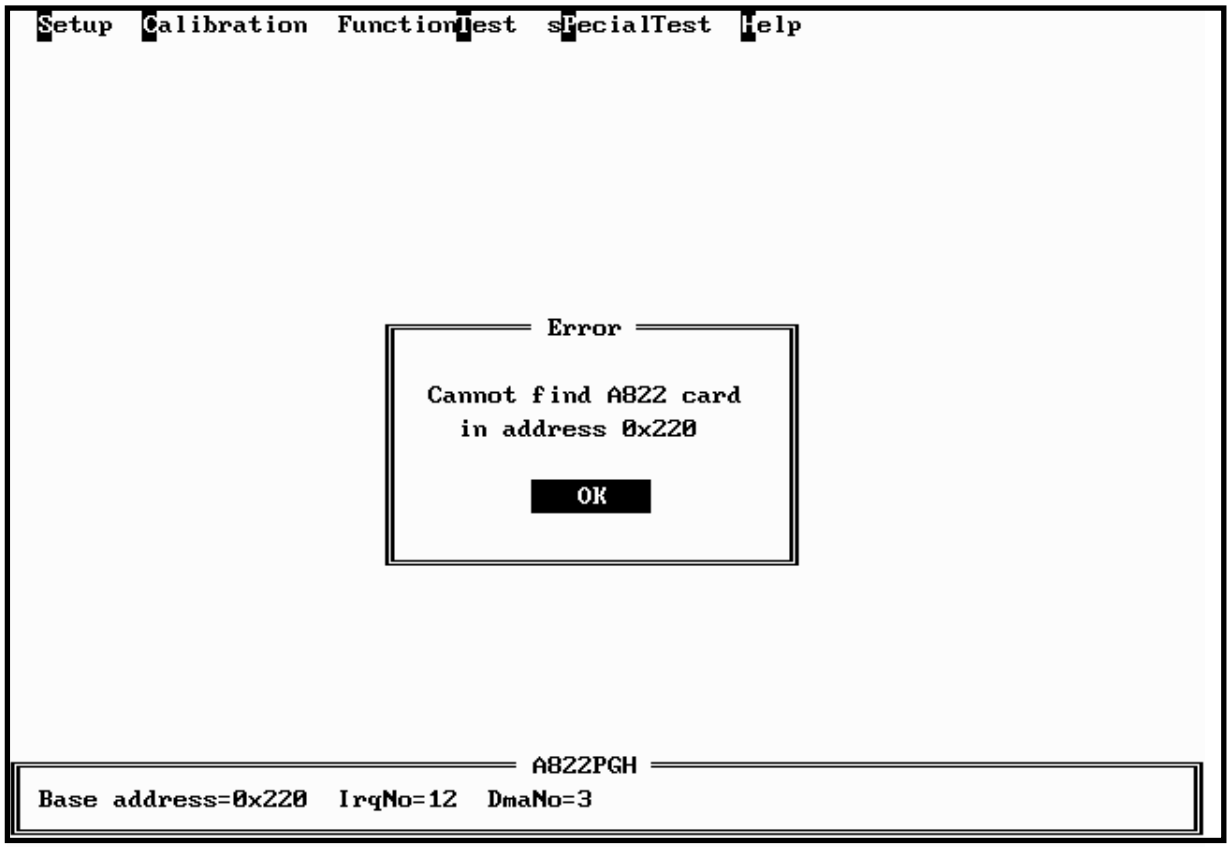
5. Diagnostic Utility

5.1 Introduction

The A82XDIAG.EXE diagnostic utility is a menu-driven program which allows complete testing of the OME-A-822PGL/PGH board. To run the diagnostic utility, change to the subdirectory used in the installation process (C:\OME-A-822 for example). Then type "A82XDIAG" <Enter> to start the application. These steps are shown below:

C:\>CD A822<Enter>
C:\A822>CD DIAG <Enter>
C:\A822\DIAG>A82XDIAG <Enter>

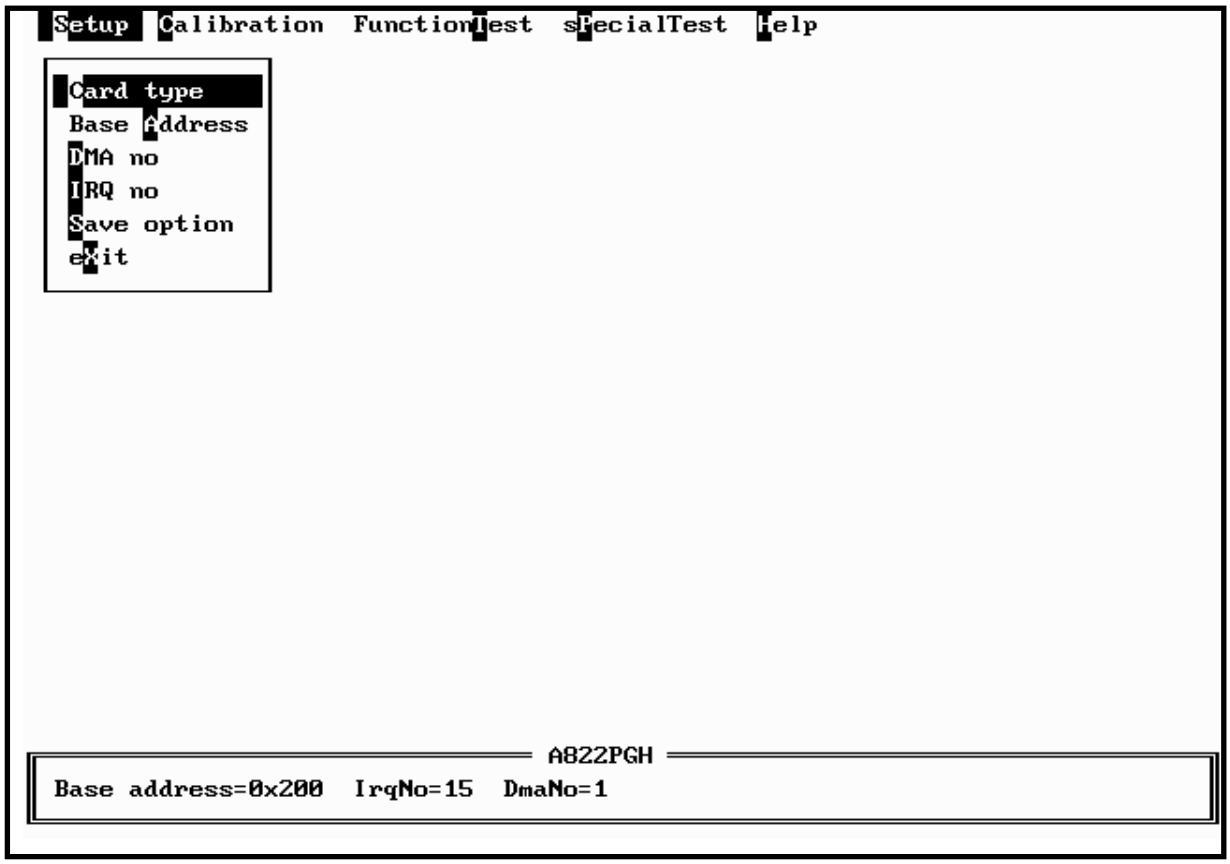
A configuration file, named OME-A-82X.CFG is associated with the A82XDIAG.EXE programThe configu ration of the OME-A-822PGL/PGH board is stored in this file. The stored information includes the board's I/O base address, interrupt number and DMA channel. Changes are not automatically saved to the configuration file, the user must select the save function to save any changes. When the A82XDIAG.EXE utility starts, it will automatically check if the jumper setting of the I/O base address matches the value stored in the configuration file. If the addresses do not match, an error message will appear as shown below.



Although you can continue by pressing any key, it is recommended that the jumper situation be corrected since many operations in the A82XDIA utility check the I/O base address and report an error if the configuration file and the actual jumper settings do not match.

5.2 Running The Diagnostic Utility

The initial screen of A82XDIAG is shown below. There are five main menus in the initial screen. They are Setup, Calibration, FunctionTest, sPecialTest and Help. Use the Left or Right key to select the main menu. Then use the Up or Down key to select the menu item. Alternately, the user can press the command key to highlight the menu item. A command key in a menu item is the character that is highlighted. To execute a function associated with a highlighted menu item, just press <Enter> and press <Esc> to abort the current function.

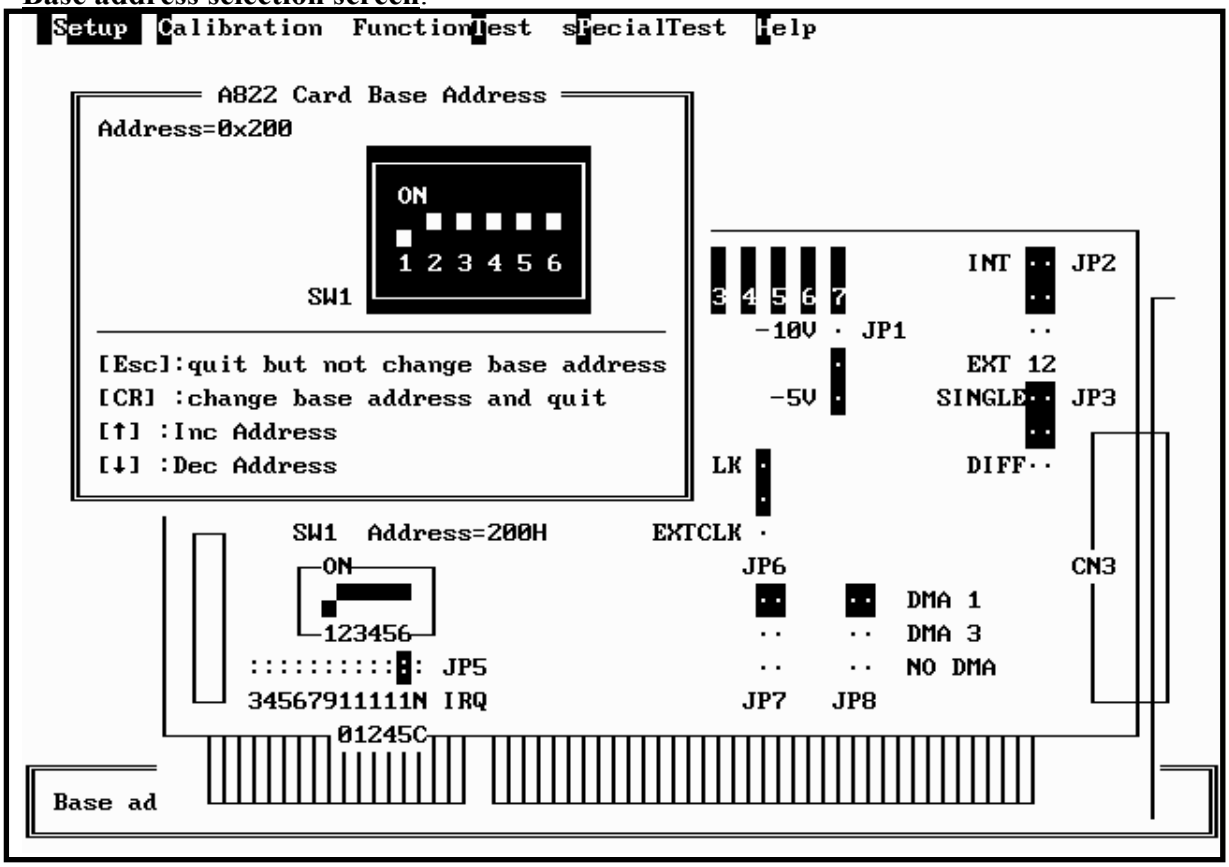


5.2.1 Setup

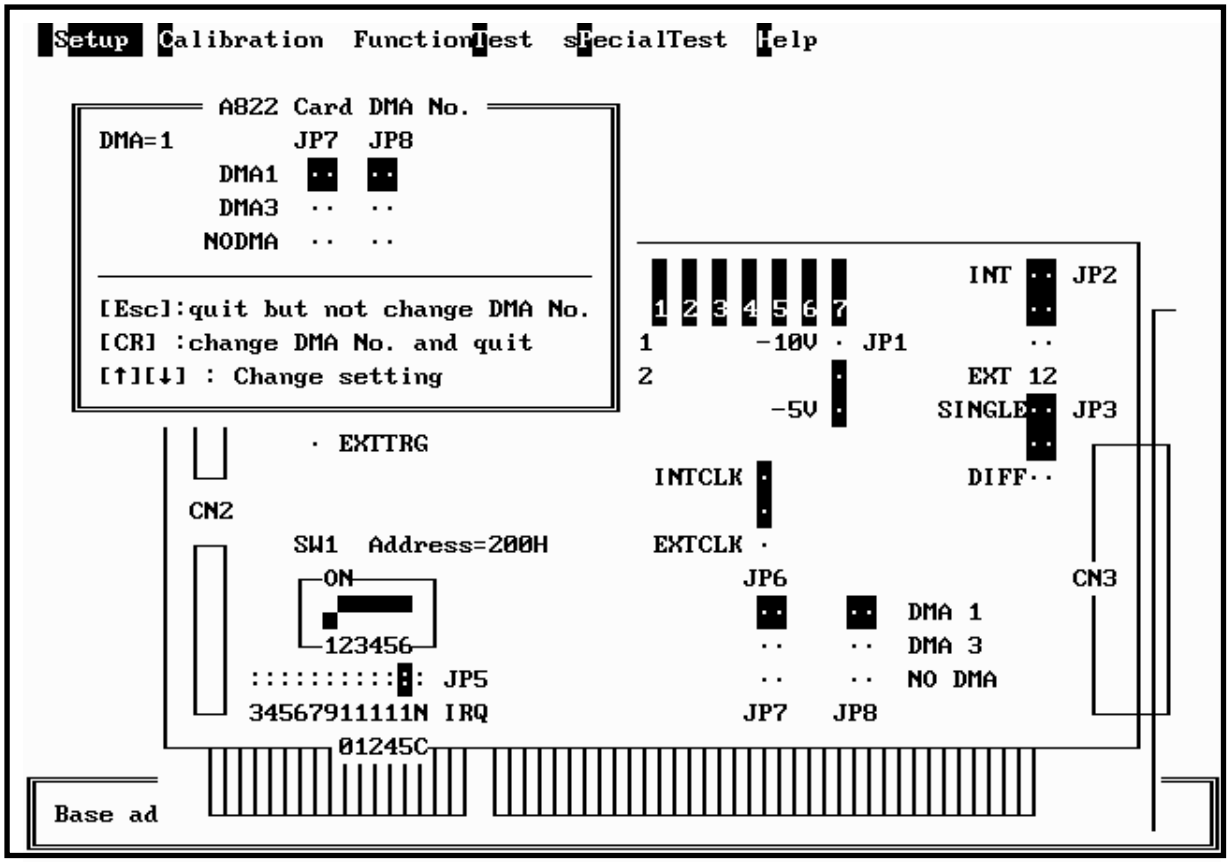
The Setup menu allows the user to setup the board configuration. There are six functions in this muen, Card type, Base Addresss, DMA no, IRQ no, Save option, eXit.

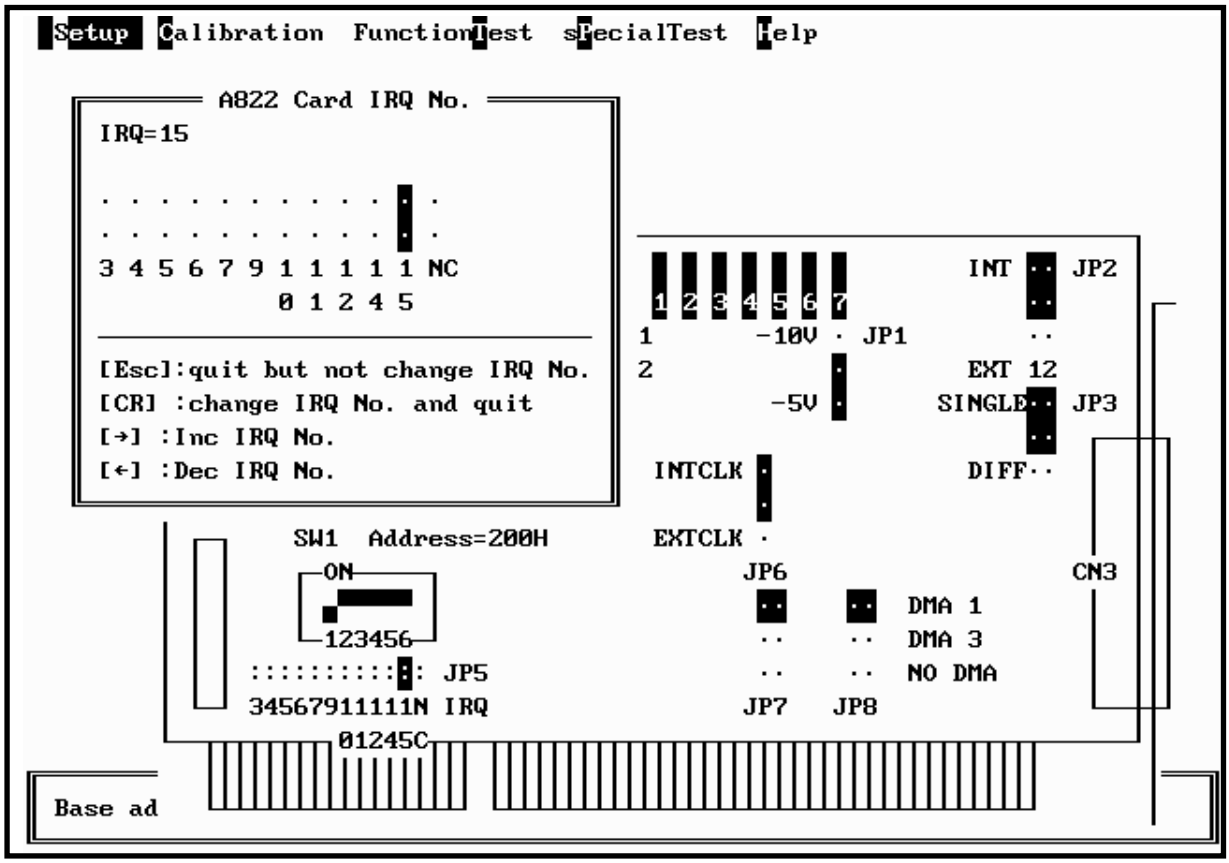
Card type : **<Up/Down>** key to select A-822PGL/PGH, **<Enter>** key to select
Base Address : **<Up/Down>** key to select base address, **<Enter>** key to select
DMA no : <**Up/Down>** key to select DMA no, **<Enter>** key to select
IRQ no : <**Left/Right>** key to select IRQ no, **<Enter>** key to select
Save option : <**Left/Right>** key to select yes/no, **<Enter>** key to select
eXit : <**Left/Right>** key to select yes/no, **<Enter>** key to select

Base address selection screen.



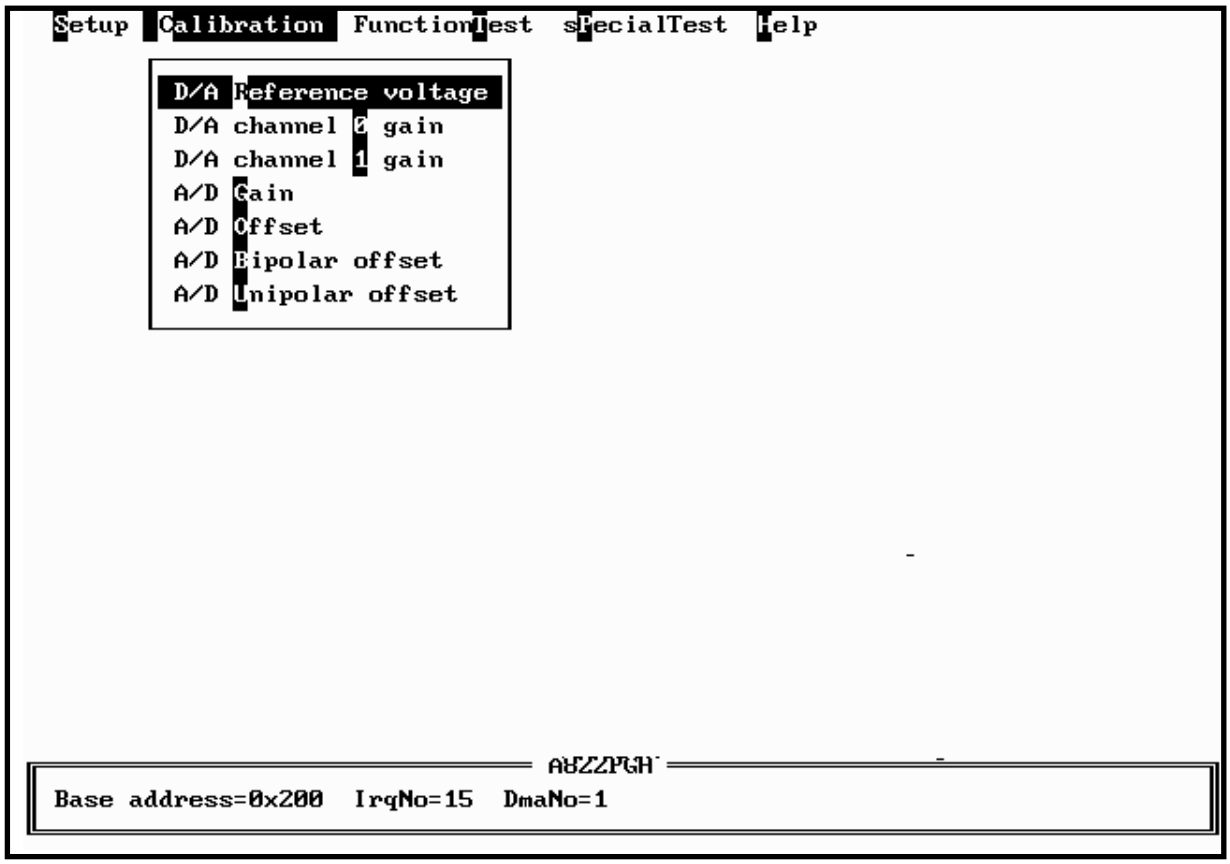
DMA no and IRQ no selection screen





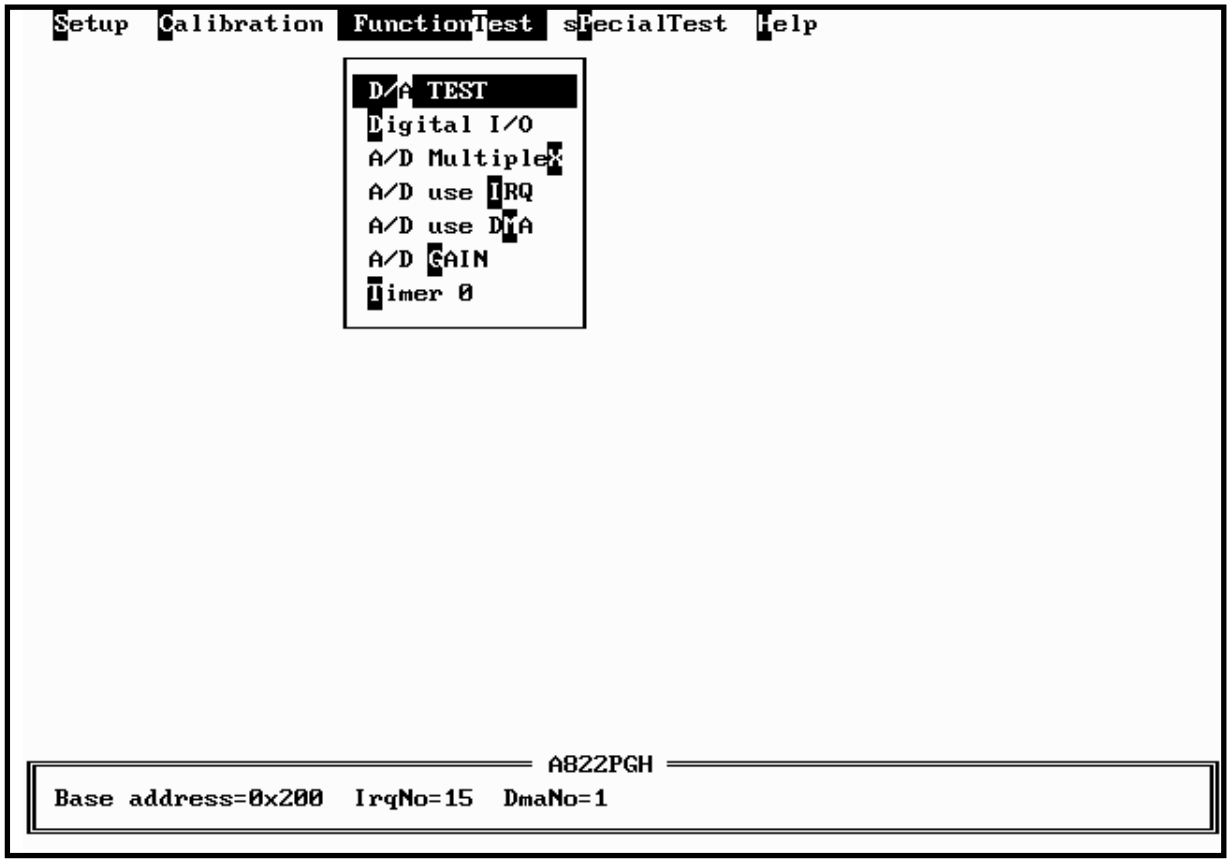
5.2.2 CALIBRATION

The CALIBRATION menu contains ten submenu items: they are, D/A Reference voltage, D/A Channel 0 gain, D/A channel 1 gain, A/D Gain, A/D Offset, A/D Bipolar Offset, A/D Unipolar Offset. These items relate to the calibration of the OME-A-822PGL/PGH. The CALIBRATION main menu, is a graphic representation of the OME-A-822PGL/PGH board layout. In order to maintain the specified performance, it may be required to calibrate the board after working with it for an extended period of time. There are seven variable resistors (VRs) that need to be adjusted during the calibration process. When you highlight one of the first seven menu items, the associated VR will begin to blink and a message window will appear that will instruct you how to adjust the VR. The main menu screen is shown below.



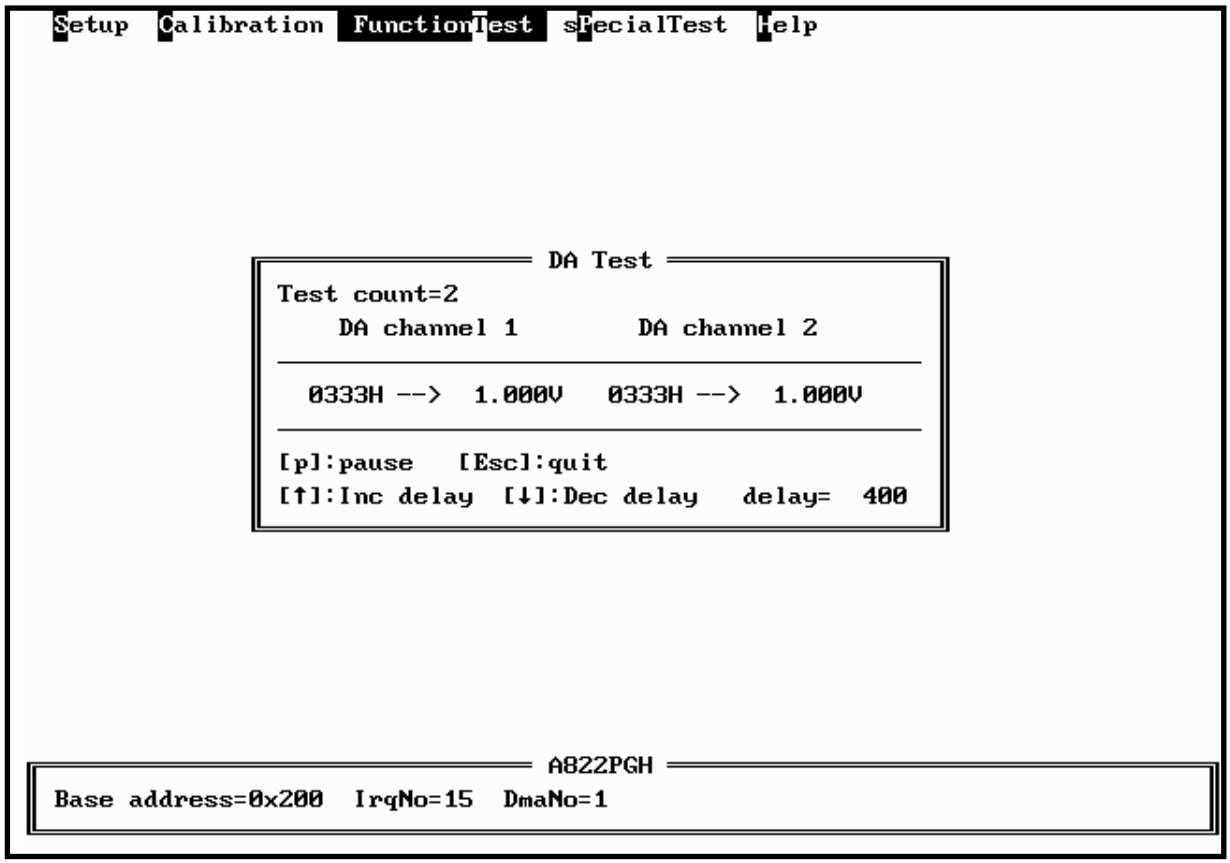
5.2.3 FUNCTION TEST

The FUNCTION TEST main menu contains seven submenus: they are D/A TEST, Digital I/O, A/D MULTIPLEX, A/D use IRQ, A/D use DMA, A/D GAIN, Timer 0. The main menu is shown below.



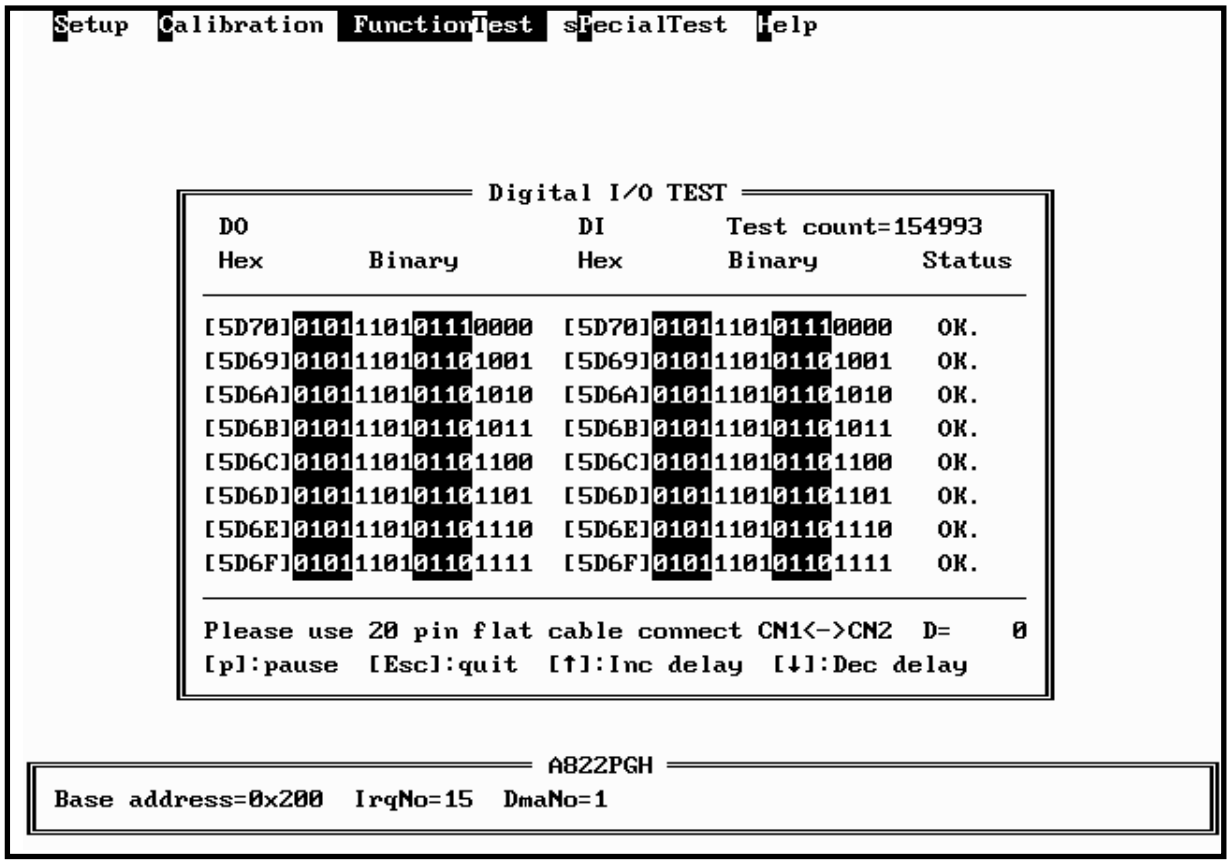
The “D/A TEST” menu, is shown below.

<D/A TEST > Test Screen



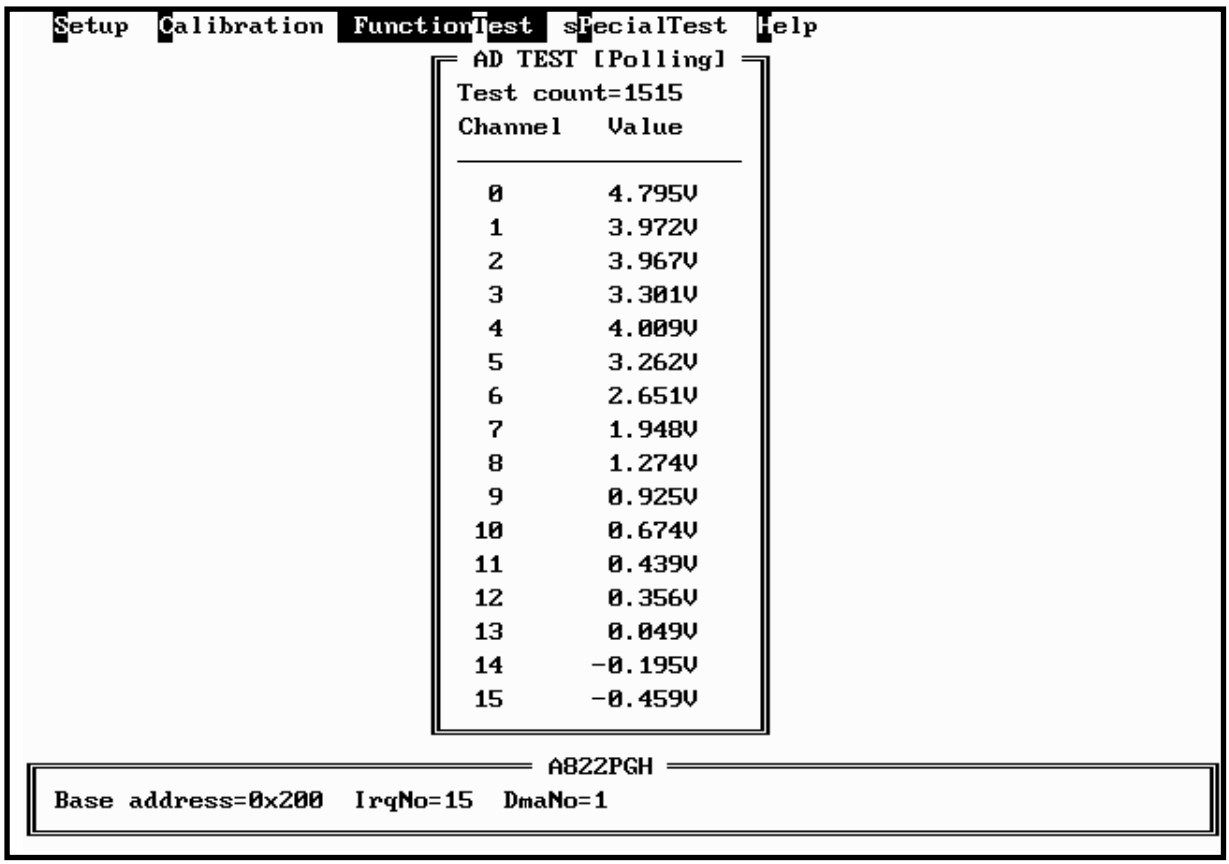
- Assume D/A output range 0 to 5V
- Send D/A output to both channels simultaneously
- Press <p> pause screen, press <p> again release screen
- Press <Up> key to increase screen delay
- Press <Down > key to decrease screen delay
- Press <ESC> key to quit

<Digital I/O> Test Screen



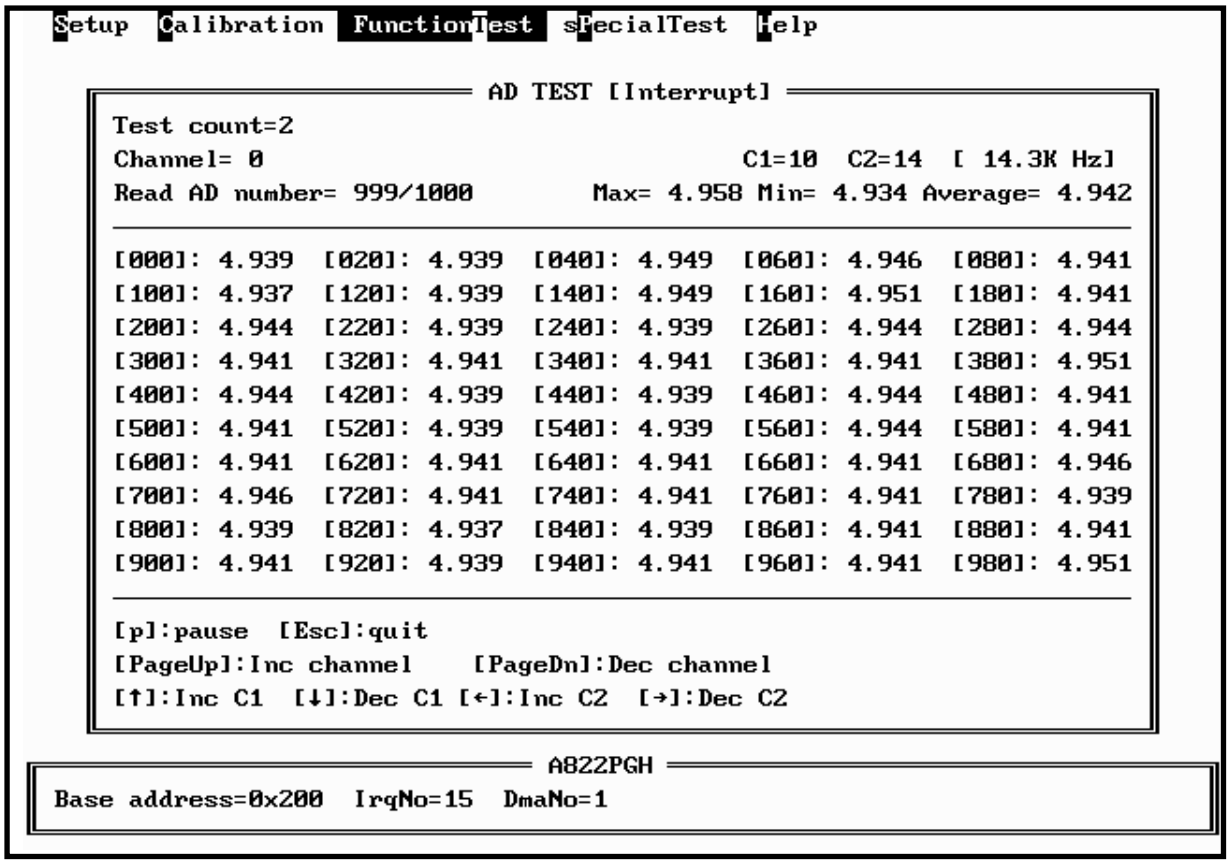
- Connect CN1 to CN2
- 16 bit up counter is sent to 16 channel DO
- 16 channel DO is connected to 16 channel DI
- 16 channel DI are readback and show on the screen
- If DO equals DI then OK shown on screen
- If DO does not equal DI then Error shown on screen
- Press <p> pause screen, press <p> again release screen
- Press <Up> key to increase the screen delay
- Press <Down > key to decrease the screen delay
- Press <ESC> key to quit

<A/D Multiplexer> Test Screen



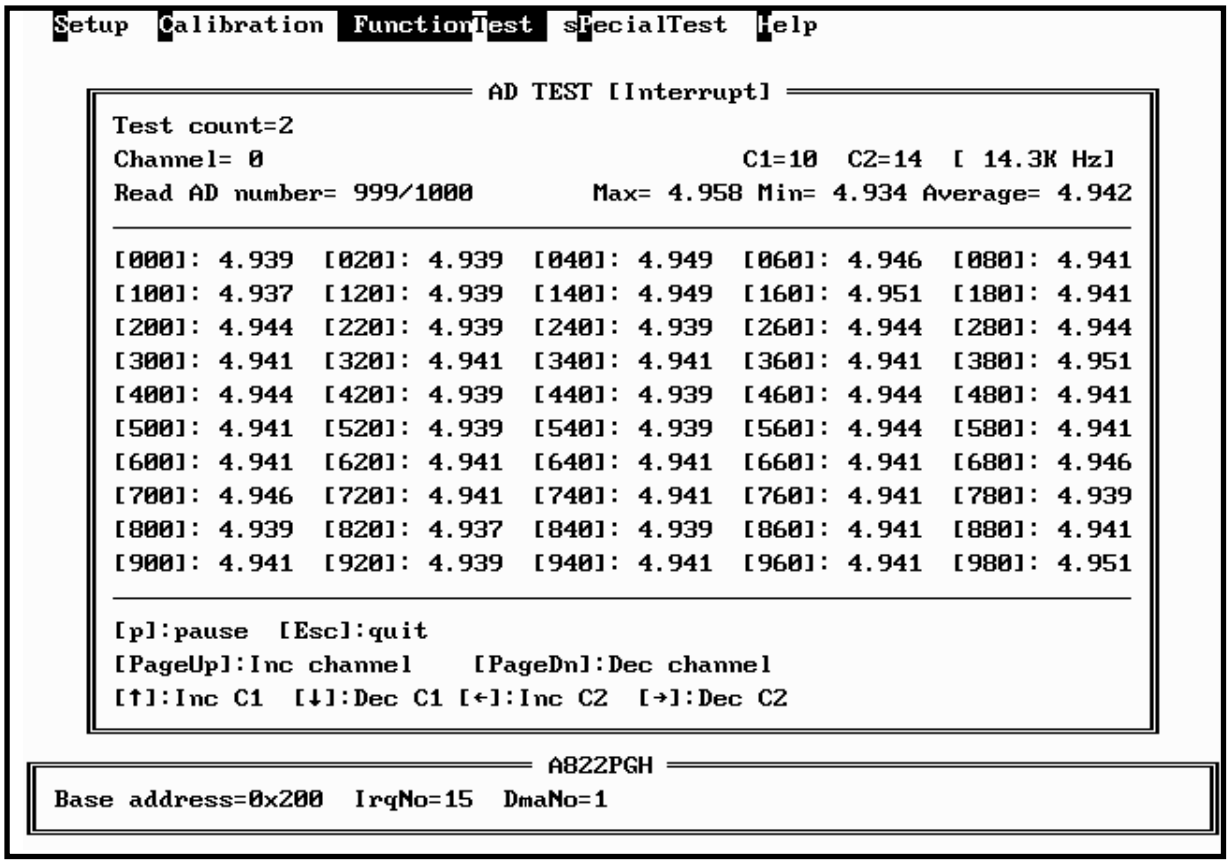
- Assume 16 channel single-ended, bipolar, gain=1, analog input signals
- Input range from -5V to +5V
- Continue to scan 16 channels
- Press <ESC> key to quit

<A/D use IRQ> Test Screen



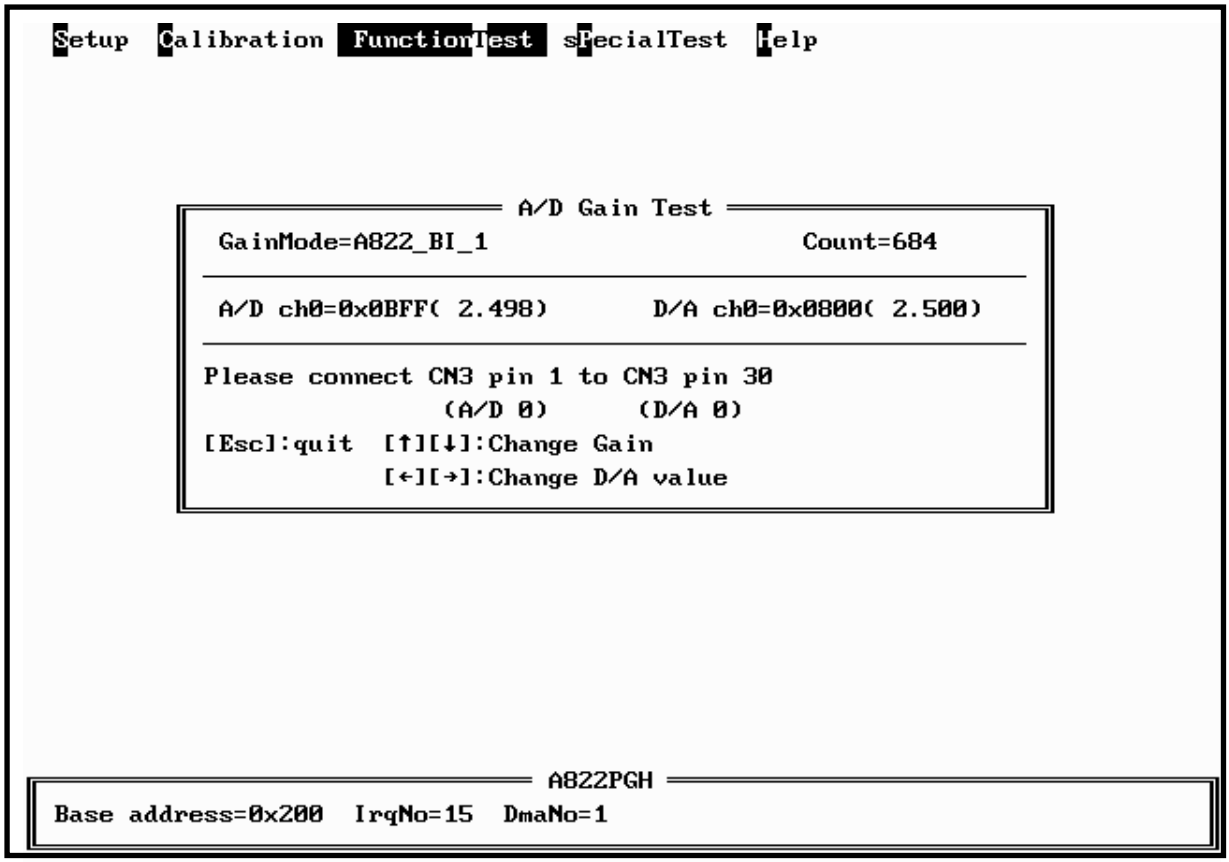
- Assume single-ended, bipolar, gain=1
- Use <PgUp> key to select the next channel
- Use <PgDn> key to select the previous channel
- Use <Up>/<Down> key to adjust C1
- Use <Left>/<Right> key to adjust C2
- The sample rate = The pacer timer rate = 2000/(C1*C2) K
- Use <p> key to pause screen, use next <p> key to release screen
- Use <ESC> to quit
- The A/D mode control register=0x06 → select pacer trigger and use interrupt transfer
- One cycle samples 1000 A/D data points
- Minimum, maximum and average values are shown on the screen

<A/D use DMA> Test Screen



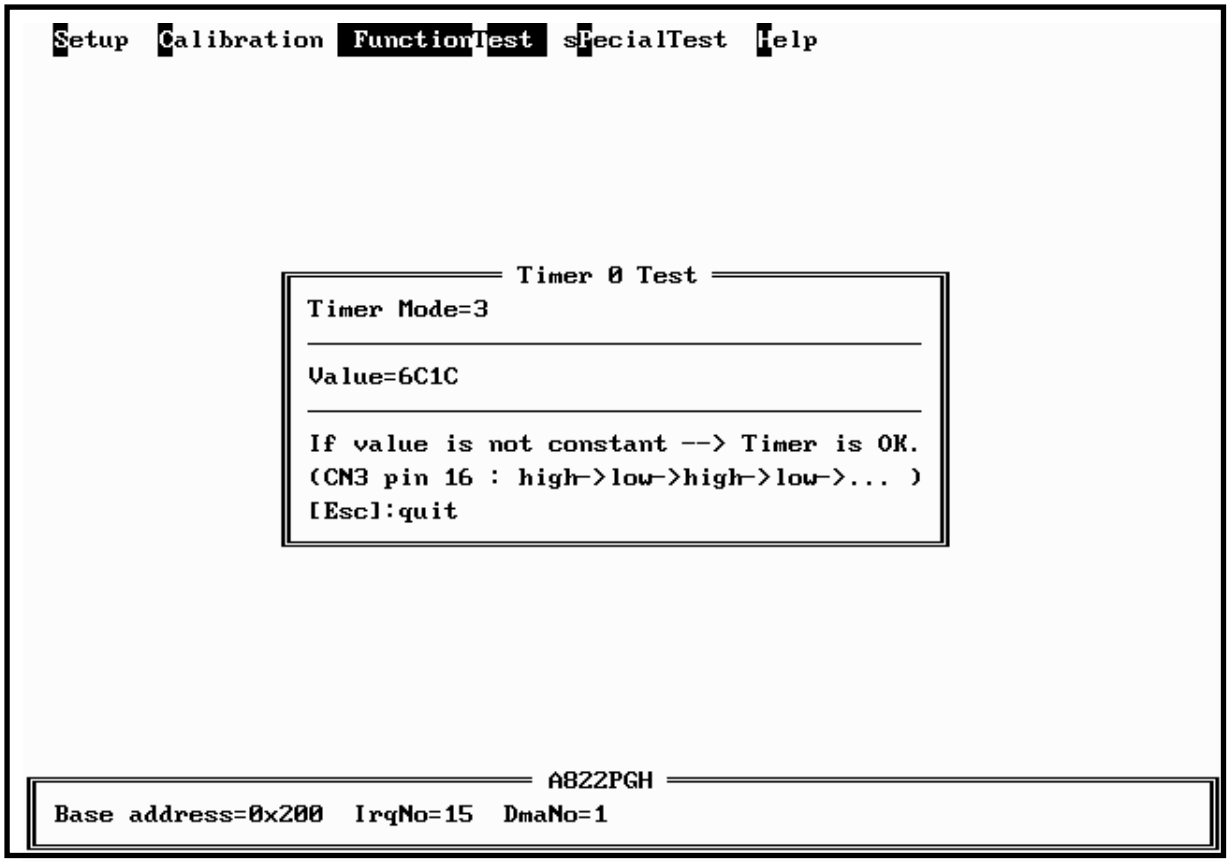
- Assume single-ended, bipolar, gain=1
- Use <PgUp> key to select the next channel
- Use <PgDn> key to select the previous channel
- Use <Up>/<Down> key to adjust C1
- Use <Left>/<Right> key to adjust C2
- Sample rate = pacer timer rate = 2000/(C1*C2) K
- Use <p> key to pause screen, use next <p> key to release screen
- Use <ESC> to quit
- A/D mode control register=0x02 → select pacer trigger and use DMA transfer
- One cycle samples 1000 A/D data points
- Minimum, Maximum and Average values are shown on the screen

<DA GAIN> Test Screen



- Assume single-ended, bipolar, gain=1, A/D channel 0 connected to D/A channel 0
- Use <Up>/<Down> key to adjust gain control code
- Use <Left>/<Right> key to adjust D/A output value
- Use software trigger and polling transfer mode
- Press <ESC> key to quit

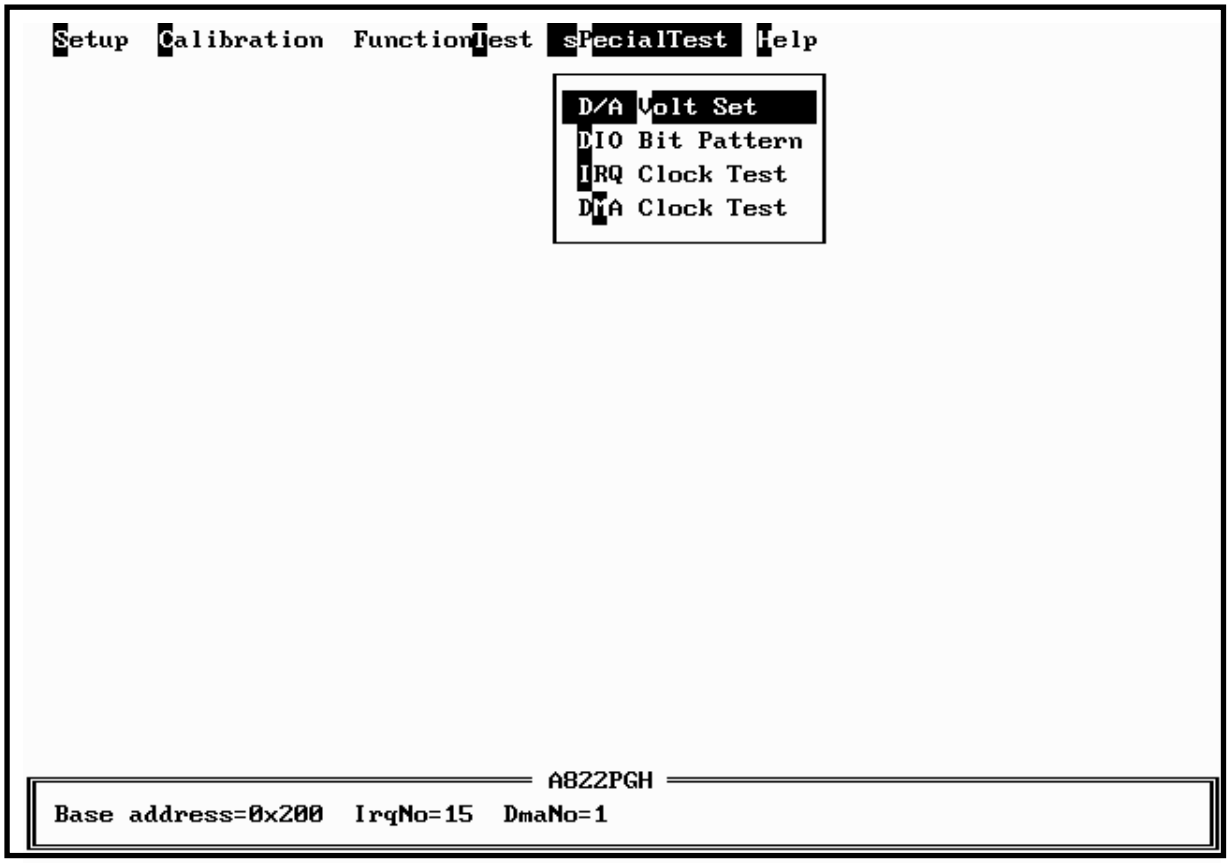
<Timer 0> Test Screen



- Assume JP6 set to internal 2M clock
- If the counter0 is functioning normally, the value will increment automatically.

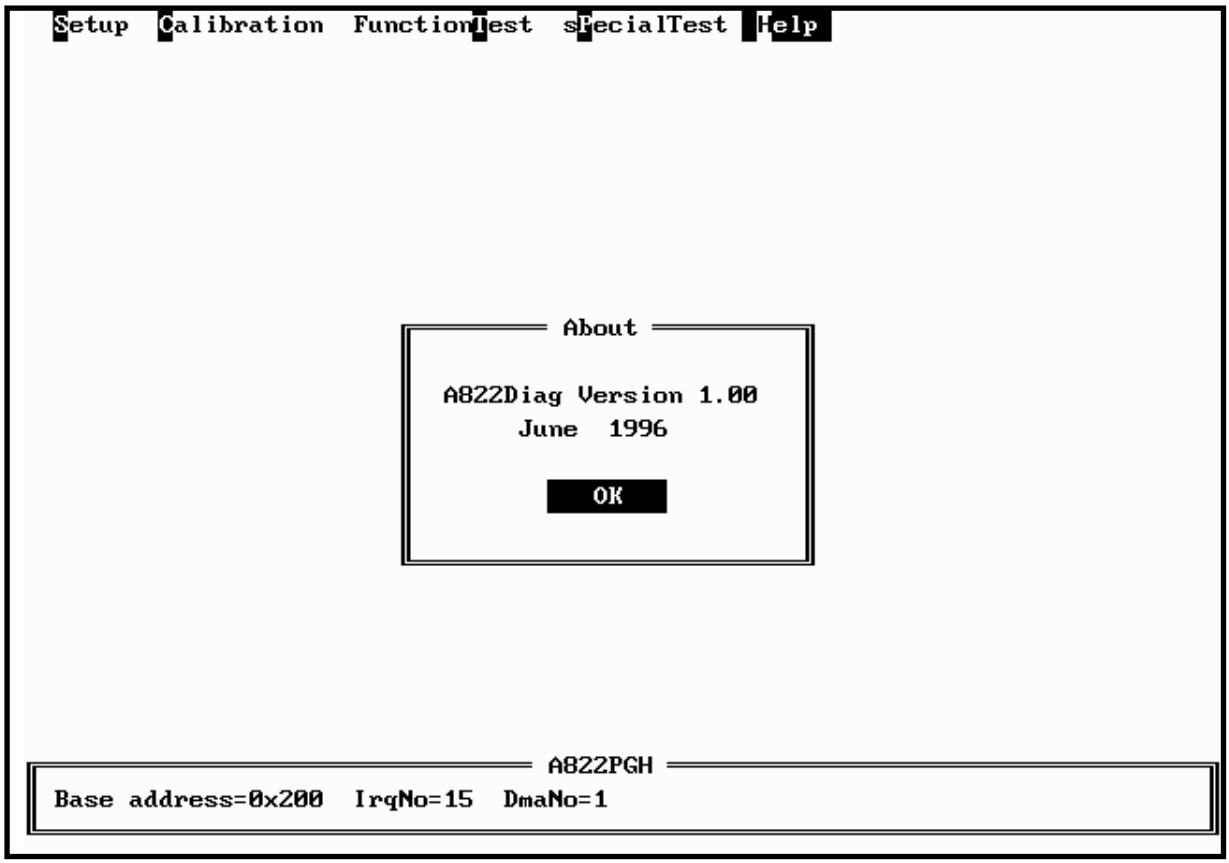
5.2.4 SPECIAL TEST

The SPECIAL TEST menu contains four submenu items: they are D/A Volt Set, DIO Bit Pattern, IRQ Clock Test and DMA Clock Test. These functions are reserved for factory testing.



5.2.5 Help

The Help menu will display the software version as shown below.



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